SERICULTURE

Instructional - cum - Practical Manual

Volume I

MORICULTURE

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Project Coordinator

राष्ट्रीय शैक्षिक अनुसंधान और प्रशिक्षण परिषद्
NATIONAL COUNCIL OF EDUCATIONAL RESEARCH AND TRAINING

June 1989
Jyaistha 1911
P D 5T - RA

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R$. 7.00

Published at the Publication Department by the Secretary, National Council of Educational Research and Training, Sri Aurobindo Marg, New Delhi 110 016, computer composed at Sarasuba Entrepreneurs Private Limited, B-164 Priyadarshini Vihar, Indraprastha Extension Delhi 110 092 and printed at Print-O-Bind, B-27, Sector VII, Noida, U P

FOREWORD

The programme of vocationalization of higher secondary education has been accepted by the country as it holds forth great promise for linking education with productivity and economic development of the country by providing education for better employability of the youth

In view of the importance of the programme the NCERT is making an all out effort to provide academic support to the implementing agencies in the States One of the major contributions of the NCERT is in the field of curriculum development and in the development of model instructional materials. The materials are developed through workshops in which experts, subject specialists, employers' representatives, curriculum framers and teachers of the vocational course are involved These materials are then sent for try-out in schools and feedback is collected through questionnaires and through direct contact. The materials are also sent to experts for comment before they are published.

The present manual on Moriculture has been developed in the manner described above and is meant for the students studying sericulture and allied vocations It is being published for wider dissemination amongst students and teachers throughout the country. I hope they will find the manual useful.

I am grateful to all those who have contributed to the development of this manual I must acknowledge also the immense interest taken by Prof. A.K Mishra, Head, Department of Vocationalization of Education in inspiring his colleagues in their endeavours to develop instructional materials Dr A K Dhote, Lecturer, functioned as the Project Coordinator for the development of this title He has my appreciation and thanks for planning, designing and conducting the workshops, for technical editing and for seeing this manual through the press.

Suggestions for improvement of this manual will be welcome.

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PREFACE

Ever since the introduction of vocationalization in our school system by several States and Union Territories in our country, the paucity of appropriate instructional materials has been felt as one of the major constraints in the implementation of the programme and a source of great hardship to pupils offering vocational studies at the higher secondary stage.

The Department of Vocationalization of Education of the National Council of Educational Research and Training, New Delhi, has started a modest programme for developing instructional materials of diverse types to fill this void in all major areas of vocational education. The task is too gigantic to be completed by any single agency but the model materials being developed by us might provide guidance and impetus to the authors and agencies desiring to contribute in this area These are based on the national guidelines developed by a Working Group of experts constituted by the NCERT

The present manual is on Moriculture and is meant for the pupils, and the teachers teaching Sericulture and allied vocational courses being offered in a number of States It contains activities (Practical Exercises) to be performed by pupils with simple steps to follow, precautions to be taken and data to be obtained and processed. Each activity is complete with Objectives, Relevant Information, Behavioural Outcomes, Evaluation, etc It is hoped that the users will find them immensely useful

The manual was developed by a group of experts as contributor in a workshop held at the Central Sericultural Research and Training Institute, Mysore. The names of the contributors and reviewers are mentioned elsewhere and their contributions are admirably acknowledged. Our thanks are also due to Shri A. K Sikdar, of CSRTI, Mysore, for the pains he took in verifying the authenticity of the contents of the manual. Dr. A. K. Dhote, Lecturer and Coordinator of this Project from the Department of Vocationalization of Education deserves special thanks for editing and bringing the manual into the present form. The assistance of all in the Central Sericultural Research and Training Institute, Mysore, and the Department of

Vocationalization of Education, NCERT, is also gratefully acknowledged.

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ACKNOWLEDGEMENTS

The following experts participated in the workshops conducted by the NCERT to develop this manual. Their participation as contributors or reviewer is gratefully acknowledged.

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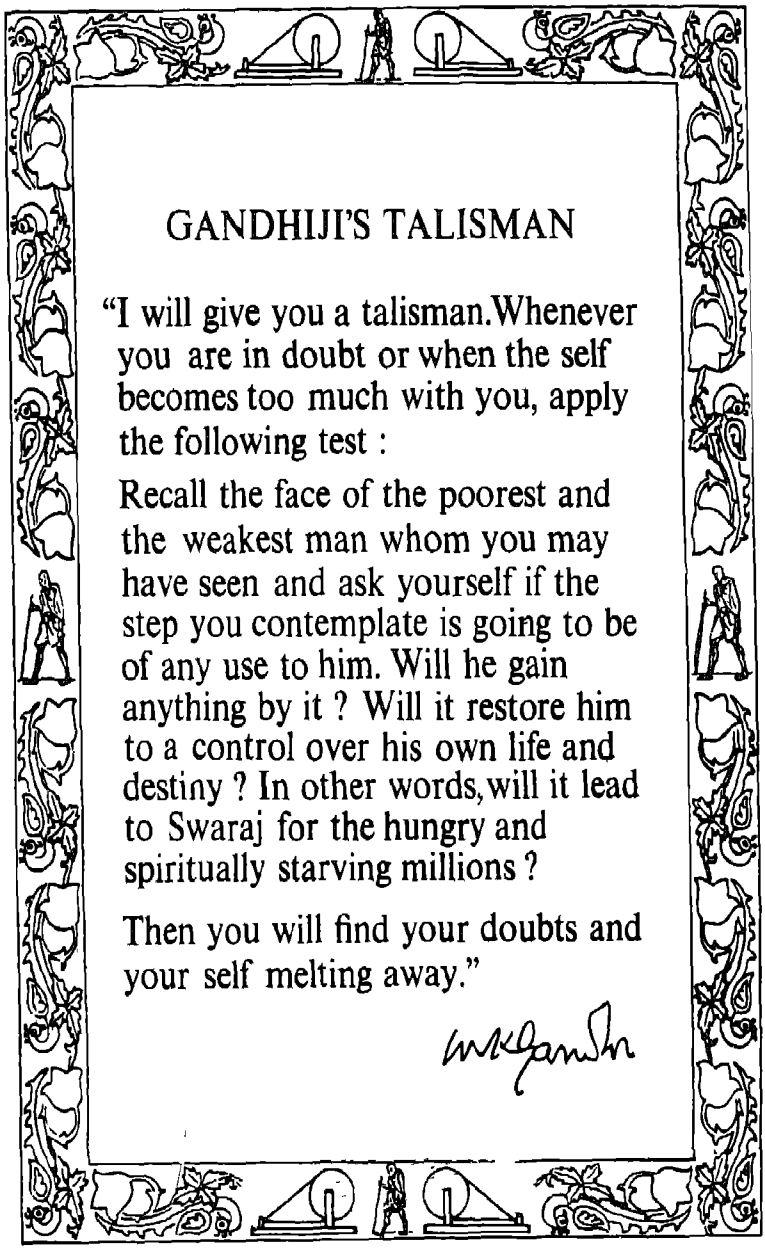


GANDHIJI'S TALISMAN

"I will give you a talisman. Whenever you are in doubt or when the self becomes too much with you, apply the following test :

Recall the face of the poorest and the weakest man whom you may have seen and ask yourself if the step you contemplate is going to be of any use to him. Will he gain anything by it ? Will it restore him to a control over his own life and destiny ? In other words, will it lead to Swaraj for the hungry and spiritually starving millions ?

Then you will find your doubts and your self melting away."

M.K. Gandhi

ABOUT THE MANUAL

Under the programme of Vocationalization of Education about 20 different groups of vocational courses in the area of agriculture have been introduced by nine States and three Union Territories so far. These courses have been running for the last six or seven years. From the very beginning, the Department of Vocationalization of Education in the NCERT has been working hand in hand with the State organizations concerned through various programmes organized for the State officials, vocational teachers and others. In fact, by now the Department has conducted on-the-spot studies of vocational programmes in a large number of States to find out the merits and demerits of the programme and to suggest appropriate measure to resolve the problems in 'vocational agriculture education'. These programmes have revealed that there was a great dearth of suitable textual-instructional materials; the need for practical manuals, especially, was urgently felt. The development of instructional materials and the imparting of practical training become even more important when one considers the purpose for which the vocationalization of education programme has been launched. The main aim of the programme is to prepare the pupil for purposeful and gainful employment (wage- earning or self-employment).

The Department constituted a Working Group, Sericulture which is an important and popular vocational course in agriculture, was selected by the Department for the purpose of development of instructional materials in a phased manner To begin with, the development of instruction-cum-practical manuals has been taken up.

The content of Sericulture and similar courses offered by the States and Union Territories under different titles was thoroughly analyzed and it was felt that six manuals would be necessary to cater to the needs of the course. The present manual on Moriculture is one of them. This manual is intended to help both teachers and pupils in the study of mulberry plants and their cultivation as preparation for this vocation. While developing the manual, care was taken that it should include the maximum number of Activity Units (practical exercises) so that it can fulfil the requirements of the course prescribed by the States and Union Territories in Sericulture as well as in other vocational courses

These Activity Units are essential to develop the required

vocational skills in the pupils. The manual explains in detail the 'what', 'why' and 'how' of these Units.

In the manual, each Activity Unit has been dealt with under several sub-heads, viz., Instructional Objectives, Relevant Information, Precautions, Materials Required, Procedure, Observations, Expected Behavioural Outcomes and Questions.

Before commencing the actual work under any Activity Unit, the teacher should know what exactly the pupils have to learn and do, and should also assess whether they will be able to do that. Therefore, in the beginning, Instructional Objectives for the pupils should be framed in behavioural terms by the teacher.

In order to acquaint the pupils with the Activity Unit, the teacher should provide them with the required theoretical knowledge or information relevant to the activity This will help the pupils to properly understand the Activity Unit. In other words, the 'what' and 'why' parts of the Activity Unit should be explained in advance by the teacher.

Once the pupils have understood the relevant theoretical instructions, the teacher should tell them about the precautions which are to be taken before and during the actual execution of the Activity Unit. This will facilitate smooth working The 'how' part of the Activity should be explained by the teacher in the 'procedure' which pupils should follow while performing the Activity Unit.

Under the sub-head 'Observations', the teacher should tell the pupils what to observe and in view of that, the pupils should observe the situation, take readings, note down the temperature and similar other points, under each Unit; these may vary from Unit to Unit. Wherever calculations are required to be done to obtain the results, this should also be indicated under this head or under a separate head.

At the end of the Activity, the pupil will have acquired certain abilities which should be closely related with the instructional objectives formulated for each Activity Unit. These abilities should be evaluated by the teacher concerned.

For evaluating each aspect, the teacher will use a four-point scale, i e., A, B, C and D and for each Activity Unit the Grade Point Average can be calculated as indicated below·

Suppose there are four aspects, each carrying equal weightage and a pupil obtains 2 A's, 1 C and 1 D and if A = 4 point, B = 3, C = 2 and D = 1 point, then, based on the grades, the pupil will get 11 points When the number of points obtained is divided by the total number of

aspects examined, it will give the Grade Point Average, which in this case is 2.75. The tabular presentation is as under:

Aspects	Weightage	Grades Obtained	TOTAL POINTS (weightage x point equivalent to grade obtained)	Grade Point Average
1	1	A	1x4 = 4	
2	1	C	1x2 = 2	11/4 = 2 75
3	1	D	1x1 = 1	
4	1	A	1x4 = 4 11	

At the end of the Activity Unit, some questions relevant to it are also given. The pupils should write the appropriate answers after the completion of the Activity Unit and the teacher should examine them. If required, he should make suitable corrections and give suggestions. However, answers to these questions will not be considered for the purpose of grading

CONTENTS

INTRODUCTION

Sericulture is a typical village-based agro-industry with minimum investment. It is labour intensive and ideally suited to a developing country where labour is cheap and abundant. During the last decade, sericulture has spread throughout the length and breadth of our country resulting in the phenomenal growth of the silk industry. Extension support at the grassroot level is essential to sustain the growth of this industry for which trained manpower too, is essential. Besides, sericulture being highly remunerative, provides ample opportunities for young people for gainful self-employment.

The mulberry leaf is the sole food of the silkworm which produces the finest natural silk in the world. It has been observed that 60% of the cost of the production of cocoons is accounted for by mulberry alone. That is why reduction in the cultivation cost of mulberry, by using the latest techniques and inputs resulting in improvement in the quality and quantity of leaves contributes considerably towards the reduction of the over-all cost of silk. In addition, increased productivity of mulberry leaves per unit area enables a farmer to increase his rearing capacity which will ultimately fetch him more income.

The success of a silkworm crop depends entirely on the quality of the mulberry leaves and, hence, a perfect understanding of the techniques of production of high quality leaf by adopting the packages drawn out in the manual would dovetail improved harvest of a silkworm crop and increased net income.

The cultivation of mulberry involves all agronomical practices,such as propagation, soil management, application of manures and fertilizers, irrigtion, weed control, etc. Knowledge of the structures and functions of plant organs and the principles involved in the various processes, will help both the teacher and the student to cultivate mulberry scientifically.

Attempts have been made to cover the whole gamut of the subject, beginning with preliminary knowledge about the food plants of silkworms followed by all the operations connected with the cultivation of mulberry, and ending in leaf harvest and farm management. The entire syllabus of the practicals has been divided into 24 Activity Units.

Each Unit has been made a self- contained one by furnishing Objectives, Relevant Information, Procedure, Observations and Calculations to be made so that the students may not find it difficult to do the practical exercises. Some model questions have also been included to assess the student's ability and to provoke his thoughts.

Since sericulture is practised in diverse agro-climatic zones of the country, the manual has been prepared keeping in view the needs of the rapidly expanding new areas extending from the tropical to the temperate climates

ACTIVITY UNIT. 1

Study of Food Plants of Different Silkworms

1.1 Instructional Objectives

The pupil should be able to:

- identify different food plants fed to various types of silkworms, namely, mulberry, tasar, eri and muga;
- know the common and botanical names of these food plants and their distribution;
- understand the habitats of different host plants.

1.2 Relevant Information

In India there are four types of silkworms, namely·

(a) Mulberry silkworm (*Bombyx mon L.*) is a monophagous insect which is reared on the leaves of mulberry only; the morin present in the leaves helps to attract the silkworm. The leaves of all the species of *Morus* are not edible for silkworms - only the succulent, glabrous and palatable leaves are suitable for silkworm feeding. The important species which are cultivated for food are *Morus alba L., M. indica L., M. latifolia Poir.*, and *M. bombycis Koidz.* In addition, a number of improved cultivars of mulberry have been evolved by the Research Institutes of the Central Silk Board, which are found to be popular in the field. Among these, mention may be made of Kanva-2, S1, S799, TR_{10}, BC_{259} and S54 Some improved cultivars from Japan and other countries have also been introduced in India with encouraging results. Some of these are, Ichinose, Goshoeorami, Kosen (Japan) and Limoncine (Italy).

Mulberry is cultivated in most States in India In the Southern and Eastern States, mulberry is cultivated as a bush whereas in the North-Western India, at a higher altitude, it is grown as dwarf and tall trees. It also occurs in the wild form in most parts of the country

(b) *Tasar silkworm* (*Antheraea mylitta D.*) is a polyphagous insect

which is reared outdoors. The important food plants of the tropical region of Central India are Sal (*Shorea robusta Gaertn.), Arjun (Terminalia arjuna* Bedd.) and *Asan (Terminalia tomentosa*, W&A). Besides these, the silkworm feeds on Ber, Jamun, etc. The temperate species of this silkworm, namely, *Antheraea proylei* J feeds on different species of oak, Uyung (*Quercus serrata*), Thunb., (*Banj ilex L.*), (*Q. dealbata Hook.F.Thom.*), *moru* (*Q. himalayana*, Bahadur), Phanat (*Q. glanca* Thunb.) and kharsu (*Q. semicaprifolia*. Smith).

Tropical tasar food plants are available in the forests of the Central Indian States, namely, Bihar, Orissa, Madhya Pradesh, parts of Andhra Pradesh, Maharashtra and Karnataka. The food plants of oak tasar silk worms are confined to the sub-Himalayan regions, namely, Manipur, Nagaland, Arunachal Pradesh, the hilly parts of Uttar Pradesh, Himachal Pradesh and Jammu & Kashmir in the wild form.

(c) *Eri silkworm* (*Philosamia ricini*) is reared indoors on castor leaves Castor (*ricinus communis* L.) and tapioca (*Manihot utilisima* Pohl.). Though these food plants grow in most parts of the country, their cultivation for silkworm rearing is confined to the Eastern and North-Eastern States of India.

(d) *Muga silkworm* (*Antheraea assama* WW.) which is semi-domesticated, thrives on *Som* (*Machilus bombycina*, King), *Soalu* (*Litsaea polyantha*, Juss.) and other species of these plants which are found in Assam, Nagaland and other parts of North-Eastern India.

1.3 Precautions

- Do not take off types of food plants for study.
- Take fresh materials as far as possible for study.
- In the case of herbarium specimens, take only the well-preserved materials.

1.4 Materials Required

(i) Live specimens of various food plants with vegetative and reproductive parts.

(ii) If live specimens are not available, well-preserved herbarium specimens with all details.

(iii) Photographs of host plants.

(iv) Map showing geographical distribution of food plants.
(v) Dissecting microscopes.
(vi) Forceps, needles, glass slides, cover slips, drawing sheets, drawing pencils.
(vii) Blotting paper, botanical press, herbarium boards and labels.

1.5 Procedure

A. Taxonomical studies

- Draw sketches of specimens of food plants with vegetative and reproductive parts.
- Dissect the floral parts of both male and female flowers.
- Draw sketches and label the various parts.
- Describe the vegetative and floral parts.
- Prepare and preserve herbarium specimens of different food plants with detailed information.

B. Preparation of herbarium specimens

- Collect fresh specimens of food plants with vegetative and reproductive parts.
- Put between sheets of blotting paper under pressure; change the papers atleast twice a day so that the moisture of the live specimens will be soaked by the blotting paper.
- After 3-4 days, when the leaf is completely dry and pressed, mount it on a herbarium board and on a label write the following description:

Name of the institution:
Name of the plant:
Habit and habitat:
Place of collection:
Date of collection:
Collected by:

1.6 Observation

The pupil should draw sketches of·
(i) specimens of food plants with vegetative and floral parts
(ii) male inflorescences
(iii) female inflorescences
(iv) male flower
(v) female flower
(vi) longitudinal section of male and female flowers
(vii) floral diagrams of male and female flowers

1.7. Expected Behavioural Outcomes

The pupil will be able to.

- identify the food plants of different silkworms;
- learn how to identify plants and prepare herbarium specimens;
- select appropriate plants suited to different silkworms.

1.8. Questions

(i) What are the different food plants of silkworms in India? Give their distribution

(ii) Underline the correct answer.

(a) *Bombyx mon* feeds on Mulberry/Asan plants.
(b) *Antheraea mylitta* feeds on Arjuna/Oak plants.
(c) *Philosamia ricini* feeds on Castor/Sal plants.
(d) *Antheraea assama* feeds on Som/Asan plants.

ACTIVITY UNIT· 2

Study of Morphology And Anatomy of a Mulberry Plant

2.1 Instructional Objectives

The pupil should be able to:

- know the morphology of the root, shoot, bud, leaf, inflorescence, male and female flowers;
- study the anatomy of the primary and secondary root, stem, petiole and leaf;
- prepare and use strains for studying the anatomical feature;
- undertake sectioning and preparation of slides;
- appreciate the function and role of each organ in plant growth and reproduction.

2.2 Relevant Information

(A) Morphology

Root. Mulberry is a dicotyledonous plant with a well developed tap root system with primary, secondary and tertiary branches. Each root tip is covered with a root cap which protects the delicate young portion of the tip. Below the root cap there is a region of elongation followed by the root hair zone. The main function of the root is absorption of water and minerals from the soil, and fixing the plant firmly in the soil.

Stem: The stem is an aerial portion of the plant which supports the foliage of the mulberry The stem is divided into nodes and internodes, each node bears a bud and two accessory buds The bark of the stem is either green, brown or grey in colour which numerous lenticells. Branching always takes place at the nodal point in the axil of the leaf. Mostly the branches are erect but sometimes they are trailing. In nature the mulberry grows as a big tree reaching a height of 20-25m with a girth of 8m. However, it is cultivated as a small bush/medium-sized tree, depending upon the type of cultivation.

Bud· Buds are found in the axil of the leaf at the nodal portion. Each bud is covered by 2-3 layers of scaly leaves of brown colour with hard texture. These protect the buds from frost and high temperature.

Below the scaly leaves, the foliage leaves are found overlapping each other and the apical meristem is situated in the centre. There are two types of buds, viz., vegetative and reproductive. Vegetative buds produce leaves and branches whereas reproductive buds give rise to male or female inflorescences in addition to leaves (Fig - 1).

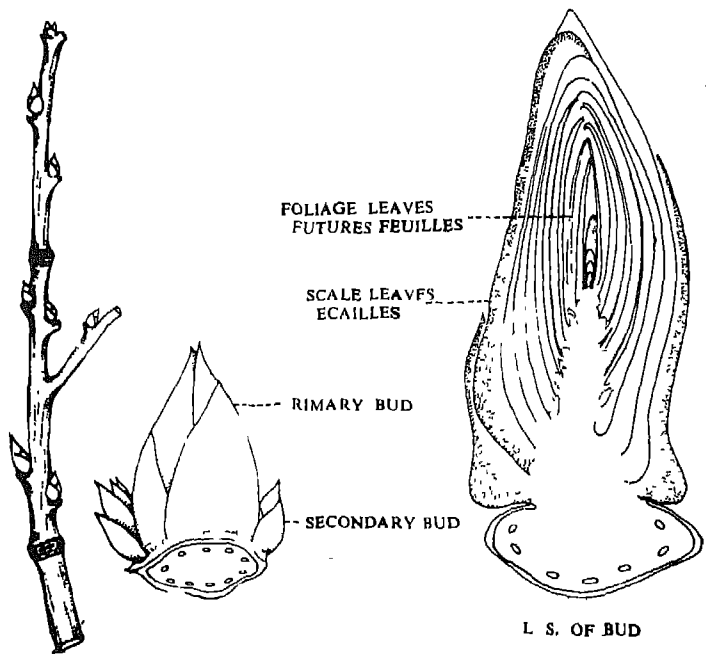


FIG 1 Morphology of bud

Leaf: The leaf which manufactures the food of the plant is one of the plant's most important organs The leaves are simple, stipulate, petiolate, entire or variously lobed The leaves are alternate and 2/3 or 2/5 ranked with different internodal lengths. Lobation starts from unlobed to highly dissected type as shown in Fig - 2. Like the lobation, the leaf apex, base and margin also differ widely. The leaf which is the most important economic unit in the sericulture industry, serves as the main food for silkworms. It should be the aim of all sericulturists to increase the leaf yield per unit area. Leaves must be succulent, smooth, less fibrous and palatable to silkworms.

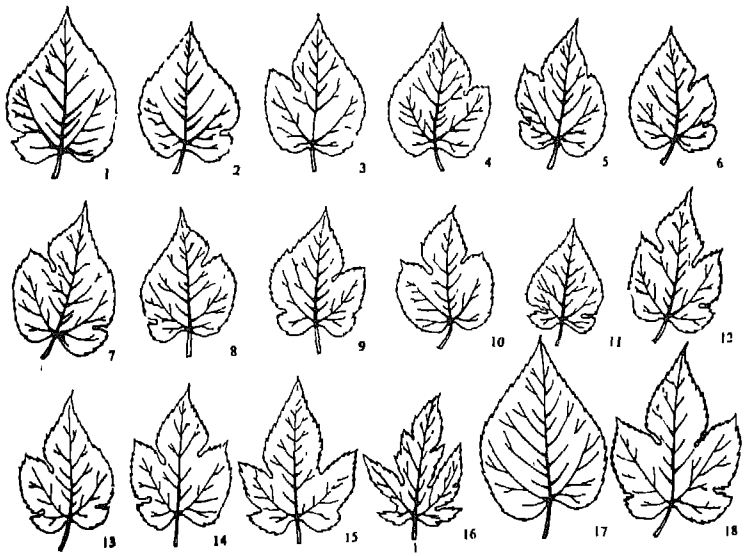


FIG 2 Leaf Lobation Pattern

Reproductive Structures: Mulberry is a dioecious or unisexual species. In some strains, monoecious forms are also found. Male inflorescence is longer in size with catkin type of inflorescence. Flowers are loosely arranged on thin rachis. Flowers are tetramerous with four perianth lobes and four anthers. Anther lobes are two in number and dehiscence is longitudinal (Fig 3 and 4). Pollen grains are light and powdery. Pollination takes place by wind. Female inflorescence is short and with compactly arranged flowers, Perianth lobes 4, ovary superior, bicarpellary, syncarpous, Ovule 1 and pendulous (Fig 5 and 6). After fertilization, the perianth lobes become fleshy and sorosis type of aggregate fruit is formed The fruit is juicy and edible and is used for preparation of jam and jelly.

(B) Anatomy

Anatomical studies of various organs help in knowing the physiological functions of the plant.

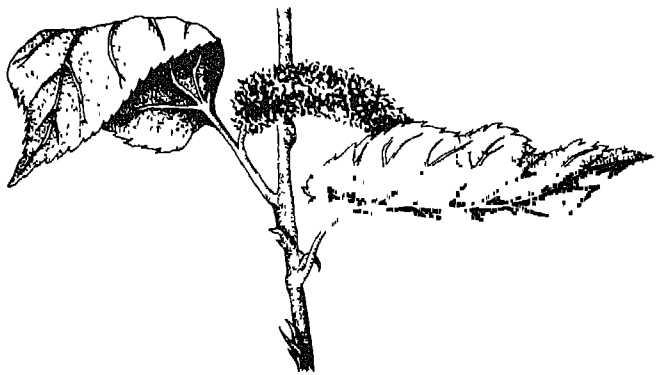


FIG 3 Male Inflorescence

FIG. 4 Female Inflorescence

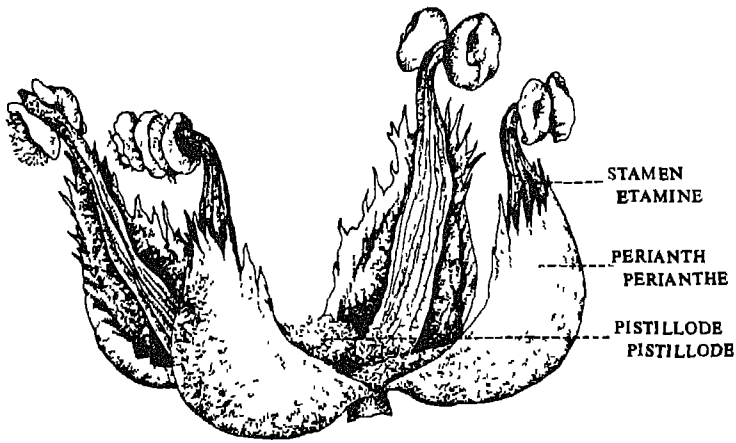


FIG 5 Male Flower

Root· The anatomy of the primary root is typical of a dicotyledonous plant The epidermis is of a single elongated layer of cells. The cortex is the next layer of cells made of parenchyma cells with intercellular spaces. Vascular bundles are exarch with metaxylem towards the centre and protoxylem radiating towards the periphery. Vascular bundles are diarch and covered by a single layer of endodermis. The pericycle is of many layers. (Fig - 7).

Secondary growth in roots starts from the formation of the cambium from some of the parenchyma cells outside the protoxylem. The cambium divides continuously and forms a circular cambial layer. This cambium cuts cells both outside and inside, forming secondary xylem and secondary phloem. Medullary rays are also formed between the vascular tissues. (Fig - 8).

Stem. The primary stem consists of single layered epidermis with tubular cells; some of these cells are drawn into elongated unicellular hairs. The cortex is many layered paranchyma cells and there are many lacticiferous cells There are a few vascular bundles of the collateral, conjoined open type with endarch xylem. (Fig - 9).

The secondary stem consists of a cutinized epidermis with many lenticellular openings for the exchange of gases,due to secondary growth, the bark shows several breakings. Below this is a layer of cork or phellum and inside this is a layer of secondary cortex or phelloderm.

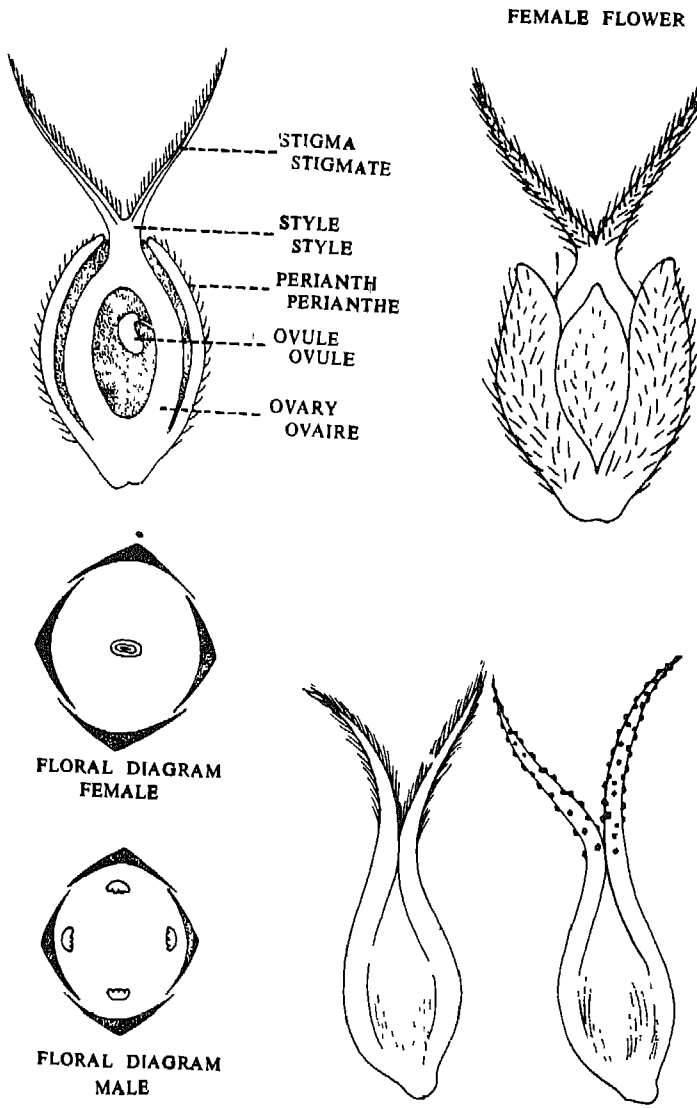


FIG. 6 Female Flower

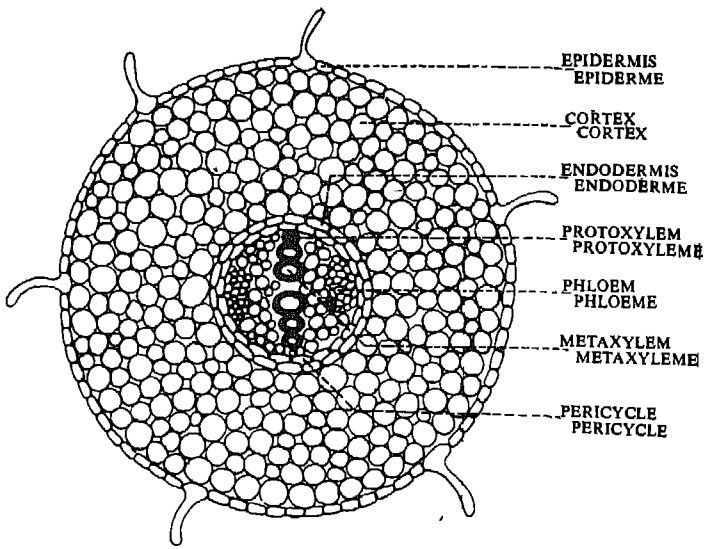


FIG 7 T S of Young Root

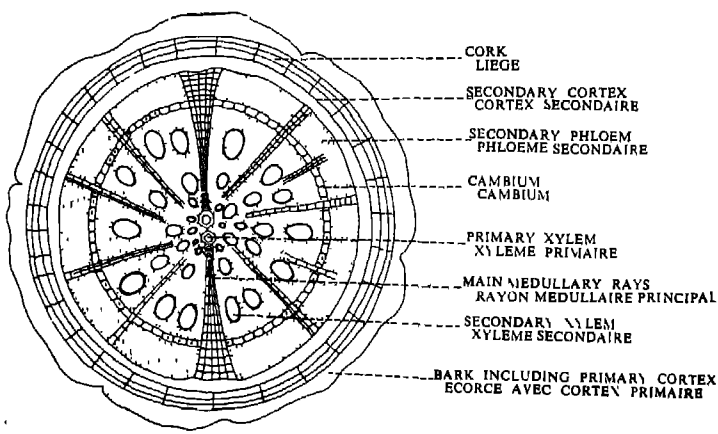


FIG. 8 T S of Secondary Root

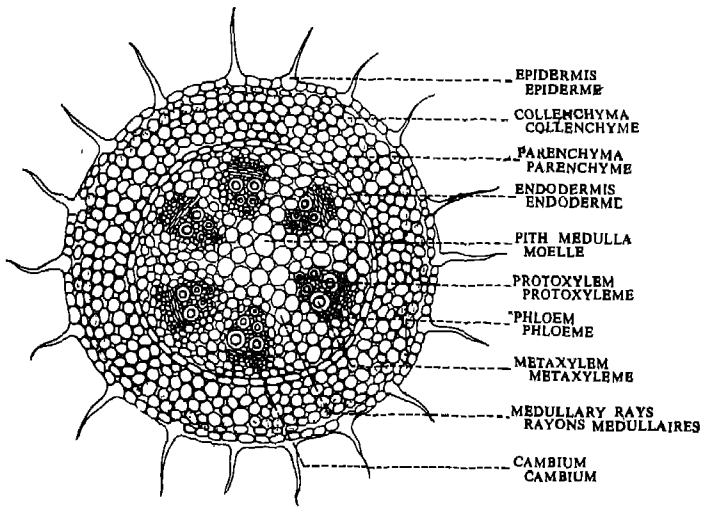


FIG 9 T S of Young Stem

The secondary cortex consists of parenchyma cells, traversed by lacticiferous cells. The secondary phloem consists of well developed sieve tubes. The secondary xylem is in the form of multilayered annulrings. (Fig - 10).

Leaf. Mulberry leaves are dorsiventral with reticulate venation. The upper epidermis consists of single layer of tubular cells without any intercellular space. Idioblasts which are found in the upper epidermis are the storing parts of calcarious secretions. The outer cells are cutinized. Below the epidermis is a layer of palisade tissue with elongated cells containing chlorophylls. The next layer is spongy parenchyma with intercellular space. The lower epidermis is interrupted by a large number of stomata. Each stoma is guarded by two kindney-shaped guard cells, and supporting subsidiary cells. Vascular bundles are found parallel and the midrib portion has maximum vascular tissue. Vascular bundles at this portion are arranged in omega shape. (Fig - 11).

(C) Preparation of sections and Staining:

For anatomical studies, sections of the respective portions are to be taken by using either a blade or razor. Usually safranin and light green are used for staining lignified and non-lignified cells

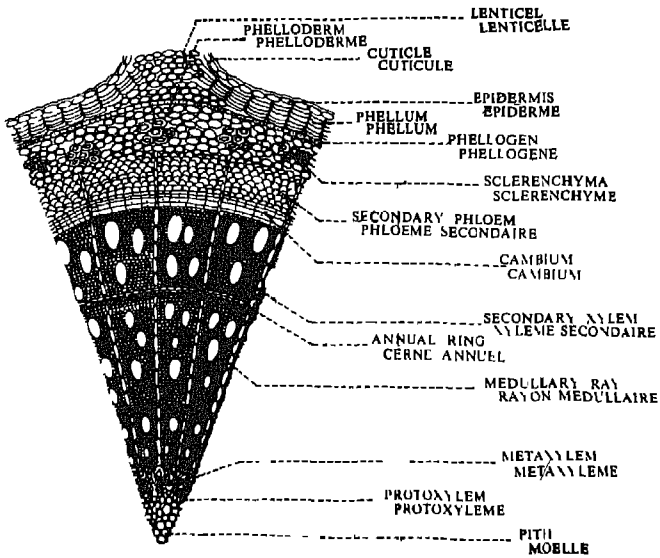


FIG. 10 T S of Secondary Stem (Portion Enlarged)

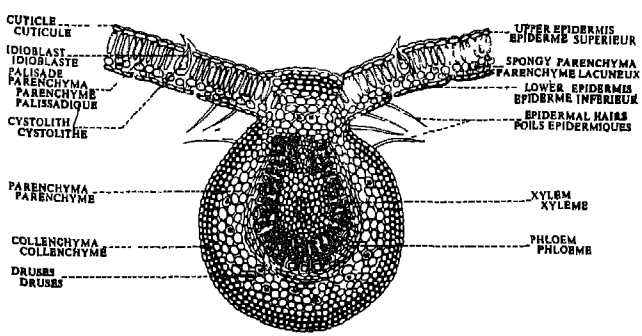


FIG 11(A) T S of Leaf (Mid Rib)

respectively. After staining, the slides are passed through a series of alcohol grades for dehydration and, finally, they are mounted

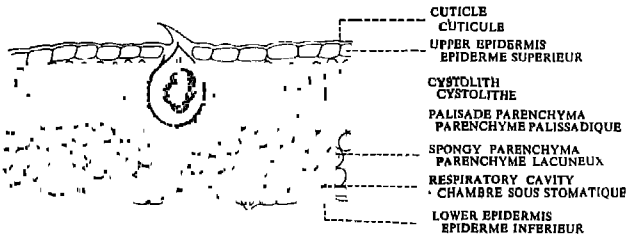


FIG. 11(B) T.S. of Leaf

in either Canada balsam or DPX Mountant.

2.3 Precautions

- use microscopes carefully;
- avoid over staining;
- select even and thin sections;
- while double staining, use separate cavity blocks for different grades;
- avoid air bubbles while mounting the specimens on slides.

2.4 Materials Required

For study of morphology

(i) Fresh specimens of stem, root, inflorescence and flower.
(ii) Dissection microscope.
(iii) Slides, cover slips, beakers and conical flasks, needles, scalpel.

For anatomical studies

(i) Microscopes.
(ii) Blades/razor.
(iii) Scalpel and forceps.
(iv) Camel hair brushes.
(v) Cavity blocks.
(vi) Stain couplin jars.
(vii) Slides and cover glasses.
(viii) Watch glasses
(ix) Stains - light green and safronin (prepared).
(x) Alcohol grades.
(xi) Canada balsam or DPX Mountant.
(xii) Slide cabinets or boxes

2.5 Procedure

For morphological studies

- Collect fresh specimens and dissect vegetative and reproductive structures.
- Observe them, if necessary, under dissecting microscopes.
- Draw neat sketches and label the different parts.

For anatomical studies

- Take thin and even sections of the materials by using a new blade/razor.
- Preserve the sections in watch glass containing water.
- In the double staining schedule, first change the sections with safronin for 2-3 minutes and then with light green for 3-4 minutes.
- Pass the sections through alcohol grades from 40, 50, 70, 95 and ethyl alcohol dipping in each for five minutes.
- Dip in xylol for five minutes.
- Observe the staining while passing through different grades to avoid over staining.
- Mount the sections in Canada balsam or DPX Mountant.
- Observe the slides under a microscope and study the various anatomical features by making suitable sketches.
- Label.

2.6 Observations

Morphology

The pupil must be able to observe.

- Variations in the morphology of root, stem, leaf, and bud of mulberry.
- Floral structures.
- Distribution of various structures like epidermal hairs, lenticells in relation to their functions.
- Role of each organ in relation to its function.

Anatomy

Students must be able to know the·

- Distribution of various tissues and component cells.
- Role of each tissue/cells in plant life.
- Leaf anatomy in relation to traspiration, photosynthesis, etc.

2.7 Expected Behavioural Outcomes

The pupil will be able to:

- study morphological features of different plant organs;
- learn about the preparation and study of anatomical peculiarities of different organs in relation to their functions;
- understand the well-knit organization of different systems in the plant.

2.8 Questions

(i) Describe the root system of the mulberry plant and the functions of the root

(ii) Describe the various shapes of mulberry leaves. Does leaf shape influence the yield?

(iii) Describe in detail the reproductive structure of mulberry

(iv) Describe with labelled sketches the anatomy of the primary and secondary stem.

(v) Describe the anatomy of a leaf.

ACTIVITY UNIT: 3

Preparation of Different Media for Propagation

3.1 Instructional Objectives

The pupil should be able to:

- understand the meaning of propagation media;
- know about different types of media and mixture of media;
- know the characteristics of a good medium.

3.2 Relevant Information

What is a medium?

A plant propagating medium is defined as any agency that helps the seed or any plant part kept in it, resulting in good germination or rooting.

Qualities of a good medium

(a) The medium must be sufficiently firm and dense to hold the cuttings and seeds in place during rooting or germination. Its volume must be fairly constant when it is either wet or dry. Any excessive shrinkage after drying is undesirable.

(b) It must be sufficiently retentive of moisture so that very frequent watering is not required.

(c) It must be sufficiently porous so that excess water drains away quickly to facilitate adequate aeration.

(d) It must be relatively free from weed seeds, nematodes and various other noxious microbes.

(e) It must have a suitable pH level. pH is a measure of relative acidity or alkalinity required for plant growth

(f) It should withstand steam sterilization without any deleterious effects.

Types of media

There are three different types of media - mixtures commonly used in moriculture and their compositions are as follows.

(a) Soil and its composition: Soil is composed of material in the solid, liquid and gaseous state. For satisfactory plant growth, these materials must exist in the proper proportions. The texture of soil refers to the relative proportion of:

(i) Sand (1 to 0 05mm in particle diameter)
(ii) Silt (0.05 to 0 002mm in particle diameter)
(iii) Clay (less than 0.002mm in particle diameter)

The principal textured classes are sand, sandy-loam, silt-loam, clay-loam and clay. A typical sandy-loam may consist of 75% sand, 14% silt and 11% clay.

Soil structure refers to the arrangement of the above particles in the entire soil mass.

(b) Sand and its composition Sand consists of small rock grains, from about 1 00mm to 0.05mm in diameter, formed as the result of weathering of vrious rocks, its mineral composition depending upon the type of the rock Quartz sand consisting mainly of silica complex is generally used for propagation purposes.

(c) Farmyard manure and its composition: This is the name given to the manure produced in the farm mainly with the animal excreta of farm animals, the litter or bedding provided for them and miscellaneous farm and household waste The FYM should be used when it is well decomposed The manurial value of FYM though not very high, helps crop production in many other ways It adds organic matter to the soil. It promotes crumb formation in soils leading to an improvement in the circulation of air and water in the soil It makes the soil porous and also increases its water holding capacity.

SUB-UNIT 3.a.

Preparation of media for potting and air layering

3.a.3 Precautions

- Make sure that the proportion of the different ingredients in the medium is correct.
- The soil should be powdery and free from pebbles.
- Take fully decomposed FYM only
- The sand used should be of medium coarse nature only.

3.a.4 Materials Required

(i) Loamy soil
(ii) Sand.
(iii) Farmyard manure
(iv) Earthen pots.

(v) Spade.
(vi) Iron pan.
(vii) Weeding sickle.
(viii) Watering can.
(ix) Ordinary field balance.

3.a.5 Procedure

Proporation of different ingredients in the mixture:

(i) For potting of young seedlings/cuttings - mix 2 parts of loamy soil
1 part of farmyard manure
1 part sand
(ii) For air layering -
1 part loamy soil
1 part farmyard manure
1 part sand

- Take the above ingredients of the mixture for the particular job, as described above, in the specified proportion
- Make the soil powdery
- Take out the stubble, pebbles, etc.,from the soil
- Take well decomposed farmyard manure
- Take farmyard manure which is free from weed roots and stony materials.
- Take medium coarse sand.
- Mix soil,farmyard manure and sand in the specified proportions.
- Add a little water while preparing the media for air layering.

SUB-UNIT: 3 b

Preparation of media for the nursery bed for raising healthy saplings

3.b.3 Precautions

- Make the soil well pulverized for deep digging.
- Soil should be free from pebbles, weeds.
- Take FYM which is fully decomposed, free from pebbles, etc.
- Add a little coarse sand to the soil.

- Make the nursery bed wide enough for a person to attend to the weeding without stepping on the nursery bed.
- Take precautions against termites by using 5% Aldrin or 10% BHC @ 20kg/ha.
- Prepare the nursery bed, the width of which should not exceed 1.5m.

3.b.4 Materials Required

(i) A piece of land.
(ii) Farmyard manure.
(iii) Sand.
(iv) Coir rope.
(v) Pickaxe.
(vi) Spade.
(vii) Weeding sickle.
(viii) 5% Aldrin or 10% BHC powder.
(ix) Iron pan.
(x) Watering can.
(xi) Handfork.

For 1 are (1/100 Ha.) land, the ingredients required are as follows:

300 kg FYM

100 kg sand (only in case the nursery bed soil is of a heavier type)

3.b.5 Procedure

- Mark a piece of land of about 1 acre area, taking care to see that the width of the nursery bed is not more than 1.5m.
- Make sure that the soil moisture is at optimum level for digging and pulverizing the soil.
- Irrigate the land in case the moisture level is less than optimum for deep digging operation.
- Dig the soil deep, upto 25-30 cms with the pickaxe and remove the weeds and pebbles.
- Broadcast farmyard manure and sand and mix them well with the soil.
- Broadcast insecticides @ 20kg/ha.
- Dig the soil again and bring it to fine tilth.
- Level the land.
- Prepare a bund all around.
- Make a channel for irrigation.

3.6 Observations

The pupil should record the following observations in the given table:

Sl No	Medium for	Ingredient	Ratio

3.7 Expected Behavioural Outcomes

The pupil will be able to:

- make the correct choice of the type of propagation media for a specific purpose.
- have a clear understanding of the desirable qualities/ characteristics of each of the different components/commonly used in the preparation of media for different purposes.

The teacher should evaluate the pupil for the above abilities.

3.8 Questions

(i) What do you understand by media of propagation?
(ii) What are the characteristics of a good medium for air layering?
(iii) Saturated media either retard or entirely prevent the germination of seeds or rooting of mulberry cuttings. Explain why this is so.
(iv) What should be the proportion of different ingredients in the potting mixture for rooting of mulberry cuttings?
(v) How do you prepare a nursery bed for growing seedlings?
(vi) Prepare a list of the equipment required in the preparation of media for propagation of mulberry.

ACTIVTY UNIT. 4

Propagation Through Seeds

4.1 Instructional Objectives

The pupil should be able to.

- know the advantages and disadvantages of seed propagation,
- know about the collection of seeds,
- know about the preservation of seeds;
- know about the sowing of seeds;
- undertake after-care given to seedlings,
- do transplantation of seedlings

4.2 Relevant Information

Propagation through seeds is one of the cheapest and easiest methods.

Merits

Mulberry being a cross-pollinated plant, sexual propagation introduces variabilities in the progeny and gives scope for selection of new varieties. It is suitable for large-scale multiplication to build up stocks for preparation of grafts.

Dements

Comparatively long gestation period to provide leaves for silkworm rearing

The desirable traits of improved cultivars cannot be perpetuated.

Source of seeds

Seeds are extracted from ripe fruits available in March-April in the tropical region and May-June in the temperate region.

Viability

There is no dormancy in mulberry seeds. Freshly harvested seeds have the highest germinability. They lose viability with the passage of time. If preserved beyond three months, seeds should be stored in a sealed air-tight container kept in a cool place

4.3 Precautions

- Collect seeds only from fully ripened fruits.
- Do not damage seeds during extraction.

- Do not preserve seeds for more than 3 months under room temperature.
- Avoid damage to root while uprooting.
- Do not sow seeds deep in the soil.
- Protect seeds from attacks of ants by dusting BHC powder around the seed pots.

4.4 Materials Required

(i) Fully ripened fruits.
(ii) Plastic tubs.
(iii) Earthen pots
(iv) Buckets.
(v) Farmyard manure and soil.
(vi) Rose cans.
(vii) Weeding sickles.

4.5 Procedure

- Select fully ripened fruits and collect them in separate containers.
- Squeeze the fruit in tubs containing water.
- Separate the pulp from the seeds.
- Remove the floating seeds
- Decant the water and keep the heavier seeds
- Dry the seeds on a piece of blotting paper.
- Prepare the sowing medium by mixing finely powdered soil with FYM in the proportion of 2:1.
- Fill up pots with the mixture upto 2 5 cm below the upper rim
- Keep the soil moisture at optimum level.
- Sow seeds individually in rows 2-3 cm apart and 1 mm between seeds.
- Water them as and when necessary when the seedlings are 4-6 months old
- Uproot seedlings and transplant them in rows either 0.9m x 0.9m or 0 60m x 0 60m depending on rainfed and irrigated conditions respectively.

4.6. Observations and Calculations

Selection of healthy seeds is done by floating the seeds in water (healthy seeds sink and shrivelled and unfertilized seeds float). Observe the number of seeds that sink to the bottom and

those that float on the surface; tabulate data as shown.

Lot No	Total No. of seeds	No of sinking seeds	No of floating seeds	% of healthy seeds

Viability test by direct germination

Lot No	No of seeds sown	Seeds germinated on 10th 12, 14 , 16, 18 & 20 day	Total	% of germination

Calculations

Total No. of seeds sown : A
No. of seeds germinated on last date: B
% of germination : B x 100/A

Surival of plants

Lot No	No of seedlings transplanted	No of surviving seeds 30th day	45th day	60th day	Survival %

4.7 Expected Behavioural Outcomes

The pupil will be able to.

- know the importance of seed propagation;
- appreciate importance of seed quality and germination percentage;
- calculate the survival percentage of seedlings.

4.8 Questions

(i) What are the advantages and disadvantages of propagation through seeds?

(ii) What measures will you take to ensure a high percentage of seed germination?

(iii) How will you calculate the percentage of survival of transplanted seedlings?

ACTIVITY UNIT: 5

Propagation Through Cuttings

5.1 Instructional Objectives

The pupil should be able to:

- understand all the implications of propagation through cuttings;
- know the characteristics of cuttings;
- know the proper method of planting;
- know the after-care required for raising healthy plants.

5.2 Relevant Information

Why propagation through cuttings?

Most of the tropical varieties of mulberry can be easily propagated on a large scale through cuttings. Propagation through cuttings has certain advantages:

(a) The process is easy, cheap and quick.

(b) Mulberry being a cross-pollinated plant, the improved traits of the cultivar are retained by propagation through cuttings.

Characteristics of suitable cuttings

(a) Cuttings must be prepared from 8-10 months old branches.

(b) Cuttings should be 10-12mm in diameter with 3-4 healthy buds (18-20 cms long).

(c) Nursery beds of proper quality should be prepared.

5.3 Precautions

- Select only those varieties which root easily through cuttings.
- Do not prepare cuttings from the portions of the shoots which are too tender or over mature.
- Avoid branches that are less than 6 months old.
- Avoid branches infested with disease/pests.
- Cuttings should be prepared without damaging the bark or splitting the base.
- Do not use a blunt instrument for preparing cuttings.

- Keep the cuttings in wet gunny cloth/bag when they are not planted immediately after preparation.
- Prepare plots carefully.

5.4 Materials Required

(i) 8-10 months old branches.
(ii) Pruning sickle/saw.
(iii) Wooden log.
(iv) Bill hook.
(v) Measuring scale.
(vi) Prepared nursery bed.
(vii) Water can.
(viii) Coir rope

5.5 Procedure

- Take 8-10 months old branches from disease free plants having good, healthy buds.
- Choose the correct branches for the preparation of cuttings.
- Prepare 18-20 cm long cuttings with a sharp implement so that neither the bark nor the wood portion is damaged.
- Plant the cuttings as suggested in Activity Unit No. 13.
- Irrigate the plot after 1 or 2 days if the soil has less moisture.
- Remove weeds once in a fortnight or as and when required.
- Apply manure and fertilizers to plots as suggested under Activity Unit Nos. 15 and 17.

5.6 Observations and Calculations

The pupil should study the percentage of survival of cuttings in the following manner, as given in the table below:

Sl No	No. of cuttings planted (X)	No of cuttings surviving on 60th day (Y)	% of survival

Percentage of survival = Y x 100/X
where X = No. of cuttings planted
Y = No. of cuttings survived

5.7 Expected Behavioural Outcomes

The pupil will be able to:

- make the right choice of parent material from which cuttings are to be prepared;
- know the correct process of preparation of cuttings;

- know the correct process of planting;
- take care of cuttings after planting.

5.8 Questions

(i) What are the salient features of good mulberry cuttings?
(ii) What precautions should you take while planting cuttings?
(iii) How will you calculate the percentage of survival of cuttings?

ACTIVITY UNIT. 6

Propagation Through Grafting

6.1 Instructional Objectives

The pupil should be able to
- know the purpose of grafting;
- know the different types of grafts;
- select scion and stock for grafting;
- know the methods of grafting;
- undertake after-care of grafts;

6.2 Relevant Information

What is grafting?

Grafting is a technique of joining the parts of two plants in such a way that they unite and grow as one plant. Grafting is usually practised where the plant cannot be propagated through cuttings because of poor rooting.

The part of the graft combination which is to become the upper portion of the shoot system of the new plant is termed as the scion and the part which is to become lower portion or the root is termed as the stock.

Basic principles of grafting
- Compatibility of stock and scion.
- Maximum cambial contact between scion and stock.
- Local adaptability of stock and superiority of scion.

Formation of graft union
- Establishment of contact of a large area of cambial region of both the stock and scion.
- Production and interlocking of parenchyma cells (callus tissue) of both the stock and scion.
- Differentiation of new cambium across the callus bridge.
- Formation of xylem and phloem from the new vascular cambium in the callus bridge.

Types of grafting

Depending upon the type of material used, and the nature, age and portion of the stock, graftings are of the following types:root grafting,

whip and tongue grafting, approach grafting, etc. In mulberry, only root grafting is practised.

Root grafting: There are two methods. *In situ* root grafting and simple root grafting. In the *in situ* method, the scion is grafted on to the root of the existing plant, without disturbing the root from its original place. Though a more vigourous plant is obtained, in this case, only once graft is developed from a seedling.

In simple root grafting, the roots from a good rooting variety are removed, cut into convenient pieces and used for grafting by inserting the scion into the root piece and planting the graft in a nursery. It is more economical for multiplication as more grafts can be prepared from the root of the plant. (Fig-12).

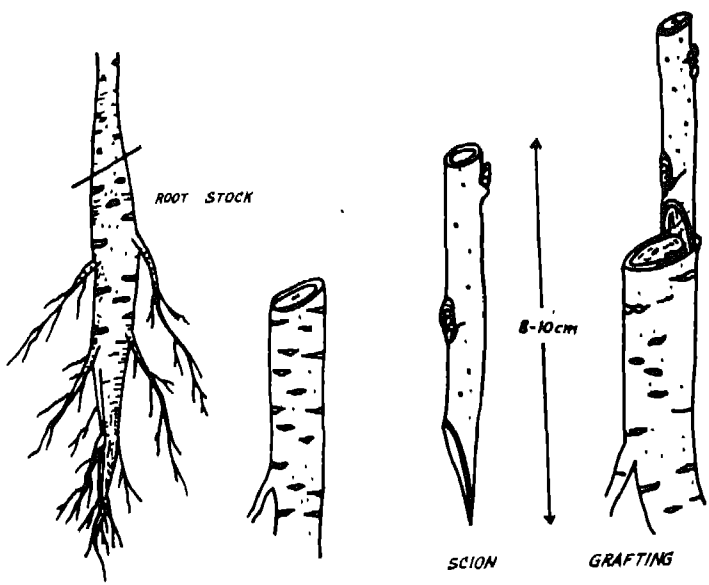


FIG 12 Root Grafting

6.3 Precautions

- Do not select weak and diseased root stock.
- The size of the scion and stock should be similar.
- Make matching cuts of equal size and shape on both scion and stock.

- Tying should be perfect to avoid entry of water and other insects.
- Do not use blunt knives.
- Do not damage the root pieces while removing them.

6.4 Materials Required

(i) Grafting knife.
(ii) Pruning saw.
(iii) Tying material - plastic strip or waxed cotton tape about 1 cm wide.
(iv) Seedlings of about 10 - 12 months age.
(v) Scion pieces of the required variety preferably of the same size as that of stock - with good, healthy buds.
(vi) Root pieces from local variety - 10-12 cm length, 1.0 to 2.0 cm diameter, with intact bark.
(vii) Wooden or bamboo sticks of about 60 cm length and 2.3 cm diameter
(viii) Secateurs
(ix) Grafting wax.
(x) Labels.
(xi) Camel hair brush.

6.5 Procedure

In situ root grafting

- Select the seedling.
- Make an oblique cut (20-30 deg.) just below the root-shoot transitional zone.
- Loosen the bark of the root stock at the tip of the cut by pressing it by hand.
- Select the scion material from a healthy shoot of the required variety. The size of the scion should be slightly smaller than the root stock.
- Cut the scion, to a length 10-12 cms containing 3-4 healthy buds. At the base of the scion piece give an oblique cut with the end tapering to provide a stiff tongue (Fig-12).
- Scrape the bark of the scion at the tongue portion.
- Insert the scion firmly into the root stock between the bark and the wood - the cut ends of both stock and scion should be in the same direction. The outside of the bark of the scion should come in contact with the inner side of the bark of the stock (Fig-12).

- Cover the exposed cut end with a thin layer of wax.
- Cover the graft union with soil, so that 1-2 buds of the scion are exposed above the soil.

Simple root grafting

- Dig out the root from a well grown local variety plant.
- Cut the roots into 12-15 cm length pieces – the diameter of the roots should be about 2.0 cm, with intact bark.
- Trim the side root - at the top end (proximal end) give a slanting cut (20-30 deg) (Fig-12).
- Prepare the stock and scion and insert as explained *in situ* grafting
- Plant the grafts in a well prepared nursery bed, or pot, so that 1 or 2 buds of the scion are above the soil.
- Water the bed or pot.

6.6 Observations

The pupil should make the following observations:

- Names of strain used for stock and scion
- Number of grafts prepared.
- Date of grafting.
- Percentage of success.

This can be calculated by following formula:

$$\frac{\text{Number of plants surviving}}{\text{Total No. of grafts made}} \times 100 = \%\ \text{success.}$$

Record your observations in the following table:

	In situ grafting	Simple root grafting
(a) No. of grafts prepared and planted		
(b) Date of grafting		
After 30 days		
(c) No of grafts sprouted		
(d) Percentage of success		
After 60 days		
(e) No of grafts sprouted		

(f) Percentage of success

(g) Height of plant

(h) No of leaves

– Remove the failed grafts and analyze the reasons for failure.

6.7 Expected Behavioural Outcomes

The pupil will be able to

– understand the importance of grafting;
– select suitable materials for different types of grafting;
– select and use the appropriate tools for grafting;
– prepare two types of root grafting of mulberry;
– judge the success of grafting;
– analyze the reasons for failure.

6.8 Questions

(i) What are the different types of grafting commonly practised in mulberry? Describe any one of them in detail.
(ii) What are the reasons of failure of grafting?
(iii) Why is grafting practised for some varieties of mulberry?

ACTIVITY UNIT: 7

Propagation Through Budding

7.1 Instructional Objectives

The pupil should be able to·

- know the importance of budding;
- know about the different types of bud grafting;
- know about the selection of plant material for bud grafting;
- know about after-care and precautions to be taken;
- perform different types of budding;
- assess the success/failure of the operation.

7.2 Relevant Information

What is budding?

Budding is also a method of grafting wherein only a single vegetative bud with a piece of bark is used as scion material That is why it is also known as 'bud grafting' and will have all the advantages of grafting. Budding is practised as a means of vegetative propagation in mulberry, particularly in temperate regions of the country.

Why is budding necessary?

Budding is usually practised whenever the scion material is scarce and involving large scion material causes disease transmission. Depending upon the types of the bud, there are various types of budding, namely, 'T' budding or shield budding, inverted 'T' budding, patch budding, flute budding, chip budding and ring budding.

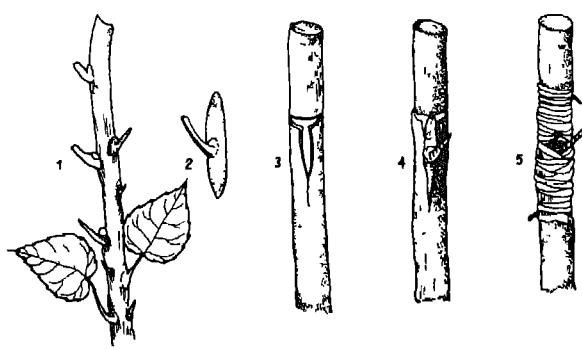
'T' budding or shield budding

This method is known as 'T' budding as the cuts given on the stock are of the shape of the letter 'T'. It is also known as shield budding as the bud prepared will appear like a shield. This method is also used for mulberry.

Method for 'T' budding

- Select the stock plant about 1-2 cm in diameter. The bark should split easily.
- Select the internodal smooth portion of the stem, preferably at the height of 25 cm from ground level.

- Give a vertical cut to a length of about 1 to 2 cm, only to bark depth.
- Give another cut horizontally at the top of the vertical cut which now appears as a 'T'. The vertical cut should be at the centre of the horizontal cut
- Gently lift the bark pieces on either side of the vertical cut for insertion of the bud
- Select the required bud
- Make a slanting cut below the bud, and lift it upward to about 2.5 cm length above the bud. Remove the bud gently.
- Insert the bud in the 'T' cut of the stock and wrap the union tightly with a polythene strip exposing only the bud (Fig-13).



1 BUD STICK, 2 SHIELD BUD, 3 T SHAPED CUT ON STOCK PLANT
4 INSERTED BUD IN T' SLOT, 5 BUD WRAPPED

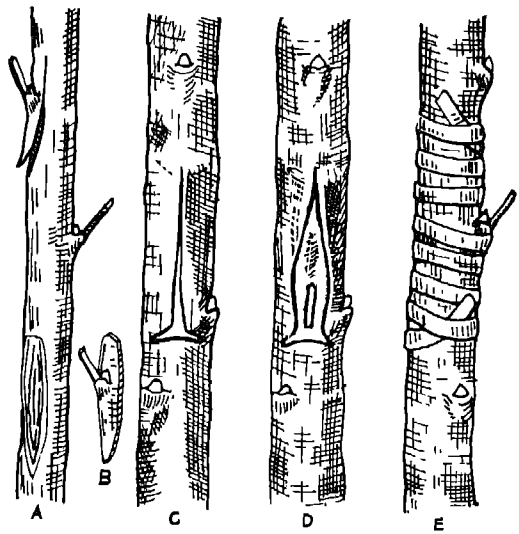
FIG. 13 T Budding

Inverted 'T' budding

This method is exactly the opposite to that of 'T' budding; in 'T' budding there is a possibility of water drops entering the cut made on the stock and damaging the bud inside. In the case of inverted 'T' budding, the horizontal cut is given at the bottom cut. In the vertical cut, the flag of the bark covers the bud and there is no chance of water entering the cut portion.

Method

The method of preparation of this type of budding is similar to 'T' budding except for the differences explained earlier (Fig-14).



A BUDSTICK, B BUD AND SHIELD, C T-CUT IN STOCK, D. INSERTED BUD, E. COMPLETED BUD GRAFT TIED WITH RUBBER BAND

FIG 14 Inverted T-Budding

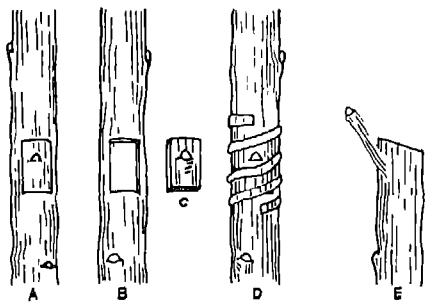
Patch budding

In this method, a patch of bark containing the bud is removed from the mother plant and put on the stock.

Method

- Remove the patch of bark, 2 cm sq. from the stock in the internodal region.
- Remove the bud with the bark of equal size from the parent stem of scion.
- Fix the patch containing the bud over a cut portion of stock and tie tightly exposing only the bud portion. While fixing the scion patch see that this should exactly fix

into the cut made on the stock (Fig-15)



A. CUT AROUND BUD, B CUT MADE TO RECEIVE BUD,
C. BUD READY FOR INSERTION, D BUD INSERTED & TAPED
E SHOOT GROWTH FROM BUD ABOUT A YEAR LATER

FIG 15 Patch Budding

Flute budding

This is a modification of patch budding. The patch removed from the stock is in the form of a ring almost encircling the stem except in a small portion, leaving the continuity of the bark. The removed portion looks like the letter 'C'

Method

The procedure of flute budding is similar to that of patch budding except that the size and shape of the cut bark removed is also 'C' in shape. Other steps to be followed are similar to those of the above method (Fig-16).

7.3 Precautions

Choose the stock and scion from healthy plants.

- Keep the size of the scion and the cut portion of the stock equal.
- Do not leave any empty space between the scion and the cut made on the stock.
- Try to get more cambial contact
- Remove all buds below and above the budded portion.

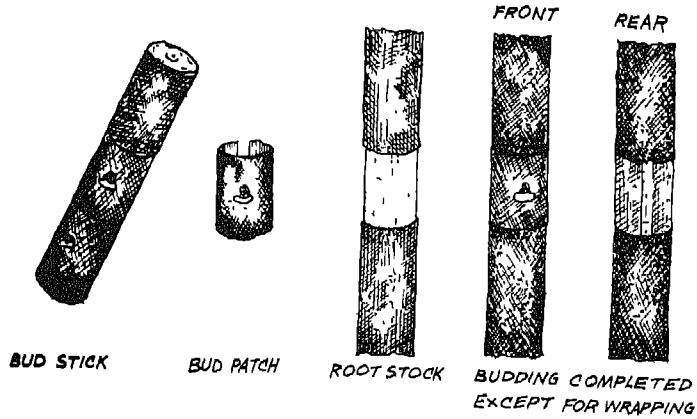


FIG. 16(A) Flute Budding

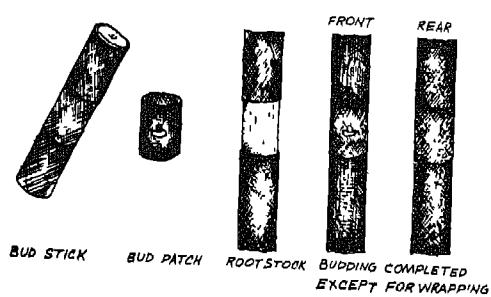


FIG. 16(B) Ring Budding

- Avoid extra damage to the stock.
- Avoid entry of water into the cut portion by wrapping it tightly.
- Do not forget to label properly.

7.4 Materials Required

(i) Suitable scion and stock material.

(ii) Budding knife.
(iii) Tying material (polythene strips).
(iv) Grafting wax.
(v) Label.
(vi) Twine thread.
(vii) Blade.

7.5 Procedure

Follow the methods as explained in 7.2

7.6 Observations

The pupil should be able to observe and record the following:

- time taken for bud union;
- percentage of success,
- comparative efficiency of each method.

Record observations after one month in the following table for each method:

Method of budding
Name of clone/variety
Name of the stock
Date of budding

Table. To assess success of budding (%)

Sl No. of budding	Time taken for sprouting of the bud after budding	No of successful buddings	% of success
1.			
2.			
3			
4.			
5			
6			
7.			
8.			
9.			
10			

7.7 Expected Behavioural Outcomes

The pupil will be able to:

- select the suitable plant material for budding;
- perform different techniques of budding and know the proper stage of union between the stock and bud;
- know the optimum time of budding.

The teacher should evaluate the pupil for above abilities.

7.8 Questions

(i) How many types of budding are there? Discuss their merits and demerits based on your experience.

(ii) Describe anyone of the budding methods in detail.

ACTIVITY UNIT· 8

Propagation Through Layering

8.1 Instructional Objectives

The pupil should be able to

- understand the importance of layering in vegetative propagation of mulberry;
- know the different types of layering;
- understand the mechanism of the development of root on a stem while it is still attached to the parent plant.

8.2 Relevant Information

What is layering?

Layering is the art of induction of roots on a stem while it is still attached to the parent plant The rooted stem is then detached, to be grown as a new plant. Such a rooted stem is known as a layer.

How do roots regenerate on the stem?

Root formation on the stem during layering is stimulated by various treatments which cause the interruption in the downward translocation of organic materials (carbohydrates, auxins and other growth regulators) from the leaves and shoot tips. These materials accumulate near the point of treatment and cause the formation of the callus. Rooting occurs on the callus

Advantages of layering

– Most methods of layering are relatively simple as compared to grafting.

Disadvantages of layering

– Time consuming and expensive, difficult for large-scale multiplication

Types of layering

There are two types of layering commonly followed for mulberry propagation,

(i) simple layering (ground layering)

(ii) air layering or gootee

SUB-UNIT 8 a.

Simple Layering (ground layering)

8.a.2 Relevant Information

In this method, a partial cut is given and the bark is removed on a branch. The branch is bent to the ground and the treated portion of it covered with soil leaving the terminal end exposed. Root initiation takes place at the bent and buried end (Fig-17).

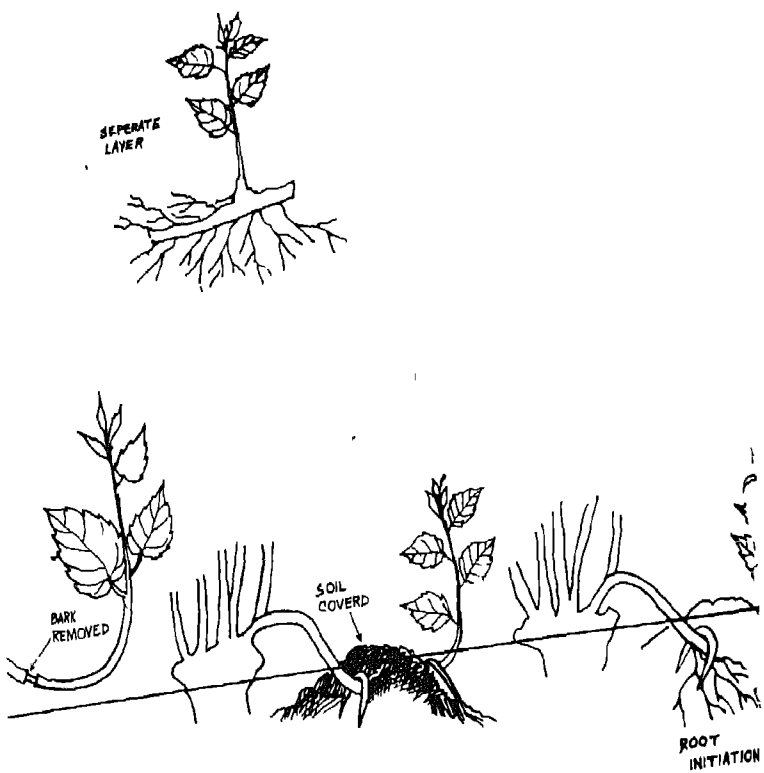


FIG 17 Trench Layering

8.a.3 Materials Required

(i) Budding knife
(ii) Pruning saw
(iii) Secateurs
(iv) Wooden pegs
(v) Water can
(vi) Loamy soil
(vii) Farmyard manure
(viii) Leaf mould
(ix) Polythene sheets
(x) Twine ball/jute string
(xi) Hand pickaxe
(xii) Wax

8.a.4 Precautions

- Select a branch for layering which is nearer the ground.
- Do not disturb the layered branch till it roots.
- Avoid woody, thick stems

8.a.5 Procedure

- Select a healthy and flexible branch near the ground.
- Give a sharp slanting inward cut at the distance of 30-40cm from tip and remove the bark
- Bend the shoot and bury the cut end in the soil, except for the tip.
- Support the cut end inside the soil with the help of a wooden peg or a fork
- Water the layered portion regularly.
- Label properly indicating date, etc

SUB-UNIT 8 b

Air Layering

8.b.2 Relevant Information

In air layering, the roots are induced on an aerial shoot The rooting medium will be provided to the shoots getting root initiation. After allowing sufficient time for root initiation, the rooted shoots are separated and planted as individual layers (Fig-18).

8.b.3 Precautions

- Do not give a deep cut while removing the bark.

- Use sterilized media for root initiation.
- Ensure constant water supply.
- Avoid insects entering the layered portion.

8.b.4 Materials Required

Refer 8.a.3.

8.b.5 Procedure

- Select a healthy branch.
- At a point 20-40 cm from the tip of the shoot, make a girdle just below the node by removing a strip of bark 2-5 cm wide.
- Scrape the exposed surface to remove the traces of phloem or cambium.
- Cover the girdle with moist propagating medium (vide Activity Unit: 3)
- Tie the girdled portion which is covered with rooting inducing medium with a polythene strip.
- Tying should be perfect so that no water or insect can enter the cut portion.
- After observing the initiation and development of roots, remove the polythene cover and cut rooted stem for planting (Fig-18).

8.6. Observations

The pupil should observe and record the following:

- Regeneration of roots on the layered shoot;
- Number of roots developed and the length of roots in each layer,
- Time taken for the layer to produce new roots;
- Record observations in the following table for each method of layering after 30 days of layering.

Type of layering:
Nature of plant:
No. of layers:
Date of layering:

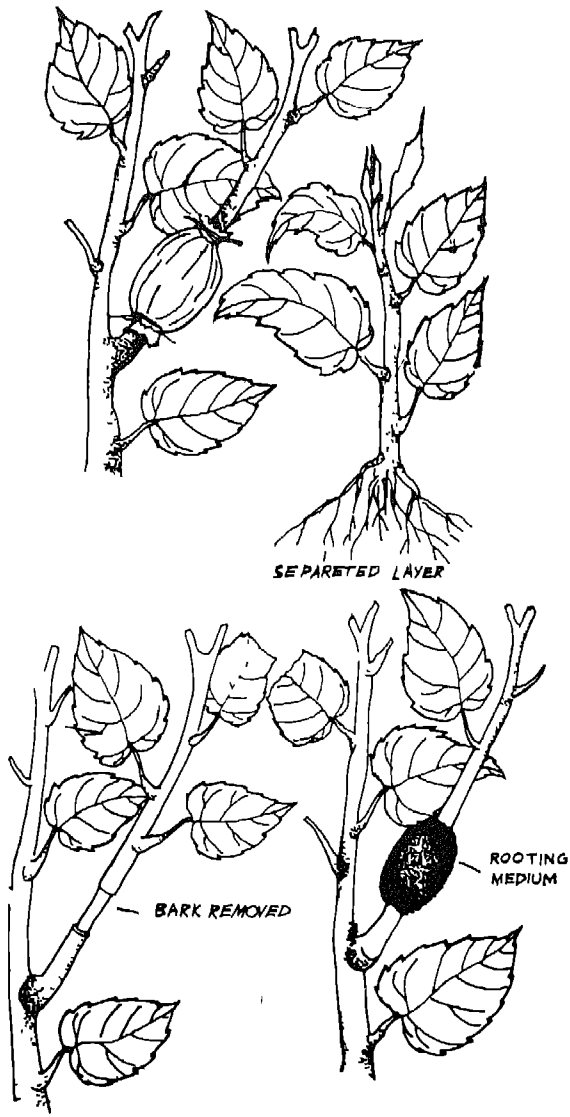


FIG 18 Air Layering

Table

Sl No. of layers	Success /Failure (+) / (-)	Time taken for separation of layer (days)
1		
2.		
3		
4		
5.		

8.7 Expected Behavioural Outcomes

The pupil will be able to:

- select the proper shoot for layering;
- learn the different techniques of layering ,
- understand the efficiency of different methods;
- know the time taken for separation of rooted layers.

The teacher should evaluate the pupil for the above abilities and suitably award grades/marks.

8.8 Questions

(i) What is layering and how does it differ from other methods of propagation?

(ii) What are the different methods of layering commonly followed for propagation of mulberry?

(iii) What is the method of initiation of roots in layering?

ACTIVITY UNIT. 9

Use of Growth Regulators in Propagation

9.1 Instructional Objectives

The pupil should be able to:

- know the common and scientific names of different growth regulators used for different methods of propagation;
- prepare the solution, powder, paste, etc of plant growth regulators;
- know the methods of application of growth regulators in cutting and air layerings for induction of rooting.

9.2 Relevant Information

Why growth regulator treatment?

In the tropical region, mulberry is commonly propagated through cuttings without any treatment. There are certain improved cultivars which possess many desirable characteristics but are deficient in rooting capacity Besides, most of the temperate varieties of mulberry are poor in rooting from cuttings Their rooting capacity is considerably improved by growth regulator treatment. Hence, it is worthwhile to propagate cuttings of such varieties with the help of growth regulators.

What is a plant growth regulator?

Plant growth regulators are complex organic compounds other than nutrients which, when applied in a minute quantity, are able to promote or inhibit growth.

Kinds of plant growth regulators

The following are some of the important growth regulators used mainly for promotion of rooting in cuttings or layering.

(i) indole 3-acetic acid (IAA)
(ii) indole 3-butyric acid (IBA)
(iii) naphthalene acetic acid (NAA)
(iv) 2,4-dichlorophynoxy acetic acid (2,4-D)

These are growth promoting chemicals which are used in inducing and promoting rooting singly or in combination.

Methods of application
Quick dip method
Prolonged dip method
Powder method
Paste method

Quick dip method

This is followed in cuttings where the concentration of the chemicals is usually higher Prolonged treatment may inhibit the growth.

Prolonged dip method

In this case the concentration of these chemicals is too low and penetration is slow. Hence, a longer period of treatment is given.

Paste method

In this method, a paste is prepared mixing the growth regulators with lanolin or a similar type of neutral, greasy material. The objective is to keep the substance for a longer time on the surface required.

Powder method

In this method, the required amount of growth regulator is mixed in talc powder or other suitable inert powder and applied to the basal portion of cuttings or the layered portion

Mode of action

Use of a growth regulator accelerates callusing, root initiation and growth by way of increasing the rate of cell division, which is not possible in a few plants due to the non-availability of these substances.

Graft unions are quickly established by increased combinal activity in grafting. Growth regulators help in initiation of meristinatic cells

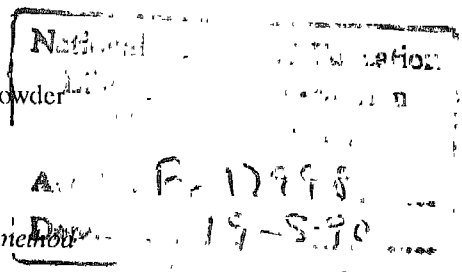
9.3 Precautions

- Prepare solutions of the required concentration carefully since a change in the concentration may affect rooting adversely
- Do not stock the prepared solutions for long periods.
- Use fresh solutions
- Give treatment for the requisite period
- Wash the material after treatment wherever necessary

9.4 Materials Required

(i) IAA, IBA, NAA and 2,4-D
(ii) 95% ethyl alcohol
(iii) Chemical balance
(iv) Measuring jar (10 ml and 100 ml)
(v) Beakers (1000, 500, 100, 50 ml)

(vi) Glass rod
(vii) Pestle and mortar
(viii) Lanolin paste
(ix) Talc or other inert powder
(x) Petridishes
(xi) Camel hair brushes



9.5 Procedure

(a) Quick and Prolonged dip method

Weigh 0.1g or 2g. of IAA, 0.2g. or 2g of IBA, 0 1g. or 2g of NAA and 0.05g or 2g of 2,4-D to prepare 100 or 2000, 200 or 2000, 100 or 2000 and 50 or 2000 ppm dilute or concentrated solution respectively.

- Prepare a solution by first dissolving it in a few drops of 95% ethyl alcohol
- Add required quantity of distilled water to get one litre of solution
- Dip the basal portion of cuttings in the solution and remove them after the given timing in the quick dip method/prolonged method, as the case may be.
- Wash the dipped end in water to avoid residual effects.
- Plant the cuttings immediately in nursery buds or in pots

(b) Powder method

- Weigh the required quantities of chemicals as mentioned under 9 5 on glazed non-sticky paper
- Grind thoroughly so that the chemical becomes fine powder.
- Mix the powdered chemical with 250 gm of talc powder.
- Transfer the mixture on to the petridish
- Take the material to be treated.
- Make the fresh cuts and touch the basal ends of the cuttings in the petridish containing the powder.
- Tap slightly to remove excess powder.
- Plant the cuttings in pots or nursery beds
- Observe survival rate after 20th day of planting and subsequently at regular intervals of 5 days each.
- A similar procedure may be followed for the layering operations.

(c) Paste method

- Weigh the required quantities of chemicals as mentioned under 9 a.

- Make it into a fine powder.
- Mix the powder thoroughly in lanolin to form a paste.
- Apply the paste uniformly to the basal cut end or the layered portion
- Plant the cutting either in nursery beds or in pots immediately without removing the lanolin paste.

9.6 Observations

The pupil should record the observations in the given table, first after 20 days and finally on the 60th day.

Date	Treatment	No of cuttings treated	No of cuttings rooted	Time taken for rooting	Percentage of success

9.7 Expected Behavioural Outcomes

The pupil will be able to·

- understand the importance of growth hormones in propagation;
- prepare the growth regulator solution/paste, etc.,
- treat the cuttings or layers by different methods.

The teacher should evaluate the students for the above abilities

9.8 Questions

(i) Why are plant growth regulators used in propagation?
(ii) What are the different plant growth regulators used for propagation of mulberry? Give their methods of application.
(iii) How do the growth regulators induce root initiation?
(iv) Compare the different methods of growth regulator treatment

ACTIVITY UNIT. 10

Soil Sampling

10.1 Instructional Objectives

The pupil should be able to·

- know the correct method of taking soil samples for testing,
- learn about the method of packing the soil sample;
- know the relevant information to be provided for soil testing

10.2 Relevant Information

Importance of Soil Testing

The availability of plant nutrients in the soil in adequate quantities and in readily usable forms is a major factor influencing crop yields For rational management, knowledge of the fertility status and physical properties of the soil is necessary. Soil testing helps in deciding the fertilizer requirement of the crop and the necessity for applying any amendments to correct the soil, etc. Soil testing is, thus, essential and a number of soil testing laboratories have been established in almost all the States where soils are analyzed quickly and recommendations are made.

Soil sampling

Soil tests and their interpretations are based on samples analyzed It is, therefore, important that the soil samples should be properly collected and should represent the area Soil test and their interpretations are as reliable as the samples drawn and hence, must be collected with care

For routine soil testing, the field is traversed and variations in slope, colour, texture and cropping pattern are noted down, the field is divided into portions according to the variations and separate samples are collected for each of the portions

10.3 Precautions

- Do not take only one soil sample from one spot
- If different areas are identified, then the sample from one area should not be mixed with that from another.
- Samples should not be collected from places where manure is

heaped, from near manure heaps or from irrigation channels.

- Avoid taking samples from spots where crop growth is luxurious
- Keep plastic and cloth bags clean and dry
- Do not use bags which have been used for storing insecticides or fertilizers
- Find out the address of the nearest soil testing laboratory before collecting the sample
- Learn the previous history of the field, the crop grown, the fertilizer used, etc
- Avoid collection of soil samples during the rainy season or when the soil is very wet

10.4 Materials Required

(i) Soil auger (4" dia) or spade
(ii) A clean sheet of thick paper of the size 24" x 18".
(iii) Plastic bags to hold 1/2 kg of soils - 4 Nos
(iv) Cloth bags of size 8" x 12" made of white drill cloth - 4
(v) Labels - 8

10.5 Procedure

- Traverse the field and identify the sampling zones, based on the slope, texture, cropping pattern
- From each zone, select a spot 2" x 2" and clear the ground of weeds, dry leaves, etc
- Remove very big stones, if any.
- Drive the soil auger (by turning it) into the soil, to a depth of 9". Lift the auger carefully and empty the soil on to the paper

or

- If a spade is used, drive the spade into the soil to a depth of 9-10", at an angle of about 45 deg and remove the soil, leaving a 'V' shaped pit to a depth of 9". Reject that soil Now again, with the spade, remove a slice of soil 3-4" thick from one side of the 'V'. Take the spade out carefully, with the soil, remove 1" of soil on either side of the slice, and transfer the central portion of the soil slice onto the paper.
- Mix the soil thoroughly
- Remove roots or any extraneous substance.
- Spread the soil on the paper and form into a square. Divide

into four equal parts and reject the two opposite quarters. Take the soil from the remaining two quarters

- In the above way, collect 2-3 samples from each zone Mix the soil sample, label it and dry in the shade (air dry) to prevent fungus formation
- Put about 1/2 kg of soil collected in the above way into the plastic bag, tie the mouth of the bag and place this in the cloth bag for better protection Tie the label to the bag
- Write the following information on the label Name, Address, and Sample No
- On a separate sheet, write the following.

Sample No.
Date of collection of sample
Address - Name
Village
Taluk
District

Type of soil

- Identification of the field (survey No of plot No. of the institution)
- Proposed crop
- History of the field - previous crop
- Fertilizer applied
- Quantity
- Irrigated or non-irrigated
- Depth of sampling
- No of samples taken to make the composite sample
- Any other useful information, like slope, drainage (satisfactory or not)
- Enclose the above with each sample
- In the above manner, collect samples from each zone identified earlier
- Send the soil samples to the nearest soil testing laboratory

10.6 Observations

- Identify the soil texture
- After the receipt of the soil test report, note the recommendations of the test report. How much nutrients are to be applied? What is the nutrient status of the soil?

From the soil test report, note the following

(1) pH of the soil

(ii) Is the soil acidic/neutral or alkaline
(iii) Total soluble salts
(iv) Quantity of organic carbon
(v) Available phosphorus
(vi) Available postassium
(vii) Category of soil

10.7 Expected Behavioural Outcomes

The pupil will be able to:

- understand the importance of collecting samples correctly;
- objectively assess the variation in the field and identify heterogenous spots;
- proficiently take soil samples and learn the procedure for soil testing,
- understand the recommendations of the soil test report.

10.8 Questions

(i) Why should we divide the field into sampling zones? Why can't we take only one sample?
(ii) Why should we dry the soil in the shade?
(iii) Why does the test report indicate available phosphorus? Is it different from total phosphorus?
(iv) Why is the soil sample taken upto 9" depth?

ACTIVITY UNIT- 11

Farm Implements and their Uses

11.1 Instructional Objectives

The pupil should be able to.

- identify the different farm implements commonly used in the cultivation of mulberry,
- know the common name of each implement;
- know the use of each of them,
- clearly understand the correct method of operation;
- know about the proper maintenance, repairs and storage of farm implements

11.2 Relevant Information

Important implements and their uses.

Spade. used for light digging, loosening soil, to prepare irrigation channel, making ridges and furrows.

Hand Kuddali- used for light digging and other intercultural operations.

Pickaxe: used for deep digging, opening of trenches, digging pits, loosening of soil, etc.

Crowbar- used for deep digging and making pits in hard soil conditions.

Digging fork: used for loosening the moist soil and mixing manures in pits.

Garden handrake. for removing stubbles, levelling land.

Weeding sickle: used for weeding purposes

Transplanting trowel: for lifting the young seedlings along with the soil.

Dibbler- for making holes at the time of transplanting of seedlings

Grafting knife. it has a single blade and is used for grafting purposes.

Budding knife: it has a single blade and is used for budding purposes

Grafting and budding knife. it has two blades used for grafting and budding separately.

Pruning saw: used for cutting thicker branches.

Pruning knife· used for pruning of medium thick branches.

Pruning sickle: used for cutting thinner branches

Secateurs. used for cutting thinner branches.

Billhook this is commonly used for cutting big branches and for preparation of branches.

Garden shears· a big pair of scissors usually used for clipping and pruning of plants.

Treepruner. used for pruning shoots in a tree of a height of5ft and above

Water can with rose· used for watering nursery beds, seed beds and potted plants to avoid washing away of the soil, and damage to young seedlings.

Iron pan. used for transporting sand, soil, FYM, etc.

Watering pot· used for irrigation of individual plants

Plough· used for ploughing the land for mulberry cultivation

11.3 Precautions

- Select the correct tool/implement for the particular job
- Check working condition of the tool/implement before use.
- Check the condition of tools/implements after use
- Clean and oil the implements properly whenever necessary.
- Store them properly.

11.4 Materials Required

(i) Spade
(ii) Hand Kuddali
(iii) Pickaxe
(iv) Crowbar
(v) Digging fork
(vi) Garden hand rake
(vii) Weeding sickle
(viii) Transplanting trowel
(ix) Dibbler
(x) Grafting knife
(xi) Budding knife
(xii) Grafting and budding knife
(xiii) Pruning saw
(xiv) Pruning knife

(xv) Pruning sickle
(xvi) Secateurs
(xvii) Bill hook
(xviii) Garden shears
(xix) Tree pruner
(xx) Watercan with rose
(xxi) Iron pan
(xxii) Watering pot
(xxiii) Plough

11.5 Procedure

Study the different tools/implements individually in detail and draw sketches giving their.

(a) common name
(b) materials they are made of
(c) working principles
(d) uses for different operations

11.6 Observations

The pupil should make the following observations in the given table:

Sl No	Name of the tool/implement	Synonyms and local names	Uses	Cost	Sketches/ illustrations

11.7 Expected Behavioural Outcomes

The pupil will be able to:

- identify and use the correct tool/implement for a particular job,
- use the tool/implement to do a specific task efficiently;
- maintain and store the tool/implement in proper working condition.

11.8 Questions

(i) Prepare a list of tools and implements required for a mulberry farm.
(ii) Make a list of the implements used in the:
  (a) preparation and maintenance of nursery beds;

(b) deep digging and preparatory tillage of land.

(iii) State and explain the uses of following

(a) Pickaxe and spade

(b) Crowbar and Hand Kuddali

(c) Pruning knife and pruning saw

(d) Hand fork and garden rake

ACTIVITY UNIT: 12

Preparation of Land for Planting

12.1 Instructional Objectives

The pupil should be able to·

- understand the importance of land preparation for planting mulberry,
- know the schedule of operations required for preparation of land;
- know the methodology for preparation of different types of land.

12.2 Relevant Information

Why is preparation of land important?

Mulberry is a deep rooted perennial plant. Its root system goes to a depth of 1-2 metres in the case of a bush That is why the land of the mulberry garden must be ploughed deep so as to facilitate the development of the root system. Well prepared land with deep digging, etc. makes the soil loose and in this condition, the plant finds it easy to establish itself

In moriculture, the economic product is the leaf. The water requirement of mulberry is pretty high, hence, the land should be cultivated deep to make the soil porous. In this condition, rain water received by the land percolates to the lower depth and is made available to the plants.

Mulberry cannot tolerate water stagnation. Proper drainage, therefore, is important in a mulberry plantation. In the case of sloping land, a terrace formation should be made, depending on the gradient The pH of soil for mulberry varies from 6 5 - 6 8 In case the soil is acidic or alkaline, it can be corrected by adding lime or gypsum as the case may be, in the right proportion

12.3 Precautions

- Initiate the tilling when there is optimum soil moisture.
- Make sure all the obnoxious weeds are removed from the land.
- Remove all the stones and pebbles from the land.

- Plough the land in one direction with a heavy mouldboard plough and leave the furrow slices exposed to the sorching sun rays so that all the root portions of the obnoxious weeds dry before doing the crosswise ploughing
- Make the land as level as possible to minimize the run-off loss of water.
- Make sure the land is ready for plantationin the very early part of the monsoon so that the newly planted mulberry plants get sufficient rain water.
- Demarcate contour lines to take up plantation in sloping land having a gradient of 15%.
- Make terraces to take up plantation

12.4 Materials Required

(i) Heavy mouldboard plough.
(ii) Disc plough.
(iii) Rotatory cultivator
(iv) Leveller.
(v) Country plough (bullock drawn)
(vi) Hand Kuddali.
(vii) Spade.
(viii) Weeding sickle
(ix) Iron pan.
(x) Gypsum or lime in the case of soil amendment.
(xi) Manures as suggested under Activity Unit 15.

12.5 Procedure

- Plough the land with a heavy mouldboard plough up to a depth of 30-45 cm taking the advantage of premonsoon showers or just after the onset of the monsoon
- Remove weeds as far as practicable.
- Plough the land crosswise to further cut down the furrow slices.
- Take up light criss-cross ploughing with the country plough.
- Remove stone, pebbles, etc.
- Level the land to make it as flat as possible with the leveller of the soil scraper; ensure proper drainage to prevent water stagnation.
- Take corrective measures by mixing gypsum or lime if necessary, after ascertaining soil pH.
- Apply farmyard manure in pits @ 10 tonnes/Ha and in

trenches @ 20 tonnes/Ha before planting in the case of rainfed and irrigated plantations respectively.

- Demarcate contour lines to take up the mulberry plantation in the case of sloping land, if the slope is between 2-6%.
- Prepare terrace for taking up plantation in the sloping land where the land gradient is between 6-25%

12.6 Observations

The pupil will observe the following:

- whether the land is properly levelled, free from weeds and soil is properly pulverized,
- soil is tilled to the proper depth,
- proper bunding in sloping land.

12.7 Expected Behavioural Outcomes

The pupil will be able to:

- plan the timing of land preparation in such a way that well pulverized land is ready for plantation as early as possible during the monsoon season;
- have a clear understanding of the objectives of the preparation of the land for the mulberry plantation.

12.8 Questions

(i) What should be the characteristics of the prepared land for mulberry cultivation?

(ii) Give the schedule of operations of land preparation for taking up of mulberry plantation.

(iii) What measures will you take to prepare land in a hilly area?

ACTIVITY UNIT: 13

Planting Systems

13.1 Instructional Objectives

The pupil should be able to:

- know the different planting systems of mulberry;
- appreciate the relevance of these systems to different conditions,
- understand their advantages and disadvantages;
- select an ppropriate planting system.

13.2 Relevant Information

Why different systems?

Mulberry is planted either in the form of cuttings or grafts. In India cuttings are planted in the tropical region and grafts in the temperate region, in the pit or row systems. These planting systms are adopted according to the availability of agronomical inputs. In irrigated and high rainfall areas, when there is enough soil moisture, mulberry is planted under closer spacing in the row/pit systems. In rainfed areas, planting is done in wide spacing in the pit system so that the number of plants per unit area is less and the competition for soil moisture and nutrients is also less.

Different systems.

Pit system: Mulberry is planted in wide spacing commonly 3" x 3" (90 cm x 90 cm). This system is practised in rainfed conditions. The advantage is that inter-cultivation is done using bullocks, as the space is wider, thus, saving on the cost of cultivation

In the pit system, leaf harvesting by plucking is practised, and pruning is done only once a year Where irrigation is available, the spacing is reduced to 2" x 2" (60 cm x 60 cm), but the leaf harvesting is done by plucking.

Row system: This system of planting is followed in irrigated and high rainfall areas. In this system, the space between rows is wider than the space between plants within the row. In Kolar District of Karnataka, the space between rows is 1 - 1 1/2" (30- 45 cm) and the space between the plants within the row is 4-6" (10 cm). Under the package of practices, the row space is 2' (60 cm) and plant

distance of 9" (22 cm) (ie. 2' x 9" or 60 cm x 22 cm) is recommended.

In the row system, higher inputs of manure and fertilizers are provided. Inter-cultivation is done only by digging. The whole shoot is harvested by pruning at the bottom in each crop and, hence, the leaf harvesting cost is low.

Tree system: All the above systems are classified as bush systems, because the plants are cut at, or just above, ground level.

When mulberry plants are pruned at a height of 2 - 2 1/2' (0.6 - 0.8 metres), they ae called middlings or dwarfs. Trees are pruned at a height of 7' (2 metres). Both the dwarfs and trees are generally given wider spacing; 4-6' (1 1/2 to 2 m) spacing either way for dwarfs and 12-15' (4-5 metres) for trees, is practised in Jammu and Kashmir. Nowadays, tree planting has been discontinued

13.3 Precautions

Select the proper planting method suited to a particular region under rainfed or irrigated conditions.

- Do not select very tender (less than 6 months old) cuttings or the top portion of the stem
- Select 10-12 mm diameter cuttings with 3-4 healthy bunds
- The planting material should be free of scale insects.
- This is a time-consuming activity, careful observation of the plots from time to time is necessary

13.4 Materials Required

(i) Hardwood (8-10 months old) cuttings 18-20 cm long with 3-4 live buds. About 450 cuttings (for one cent under each system).
(ii) Kuddali, spade, rope for marking, tape or metre scale.
(iii) Two plots each measuring one cent
(iv) Farmyard manure.

13.5 Procedure

(a) Pit system

- Measure the plot and calculate the number of cuttings to be planted under spacing of 0.9m x 0.9m and 0.60m x0.22m. It is calculated by:
  Area of the plot: Row spacing x plant spacing multiply this by two, as two cuttings are to be planted per pit.
- On one side of the field, stretch a rope in a straight line and mark every 0.9 metre.

- At a right angle to this, stretch another rope and mark again every 0.9 metre.
- On this basis, mark the field by putting a peg at the intersection points
- At the point where the peg is put, make a pit measuring 45 cm x 45 cm x 45 cm.
- Put about one kilogram of farmyard manure in the pit, fill with soil and mix.
- Plant two cuttings in each centre of the pit. Plant them at slanting position (about 60 deg C) leaving one bud exposed at the top
- Check whether the cuttings are planted the right way up.

(b) Row system

- Measure the plot and calculate the number of cuttings required in the above manner
- On one side of the field, mark at every 60 cm and also correspondingly on the opposite side.
- Make ridges and furrows every 60 cm apart.
- Apply a layer of farmyard mnure on the ridge and mix it well into the soil.
- With the help of the rope, plant one cutting every 22 cm in a row on either side of the ridge. Plant the cuttings at an angle with atleast one bud at the top Cuttings must be planted the right way up
- Irrigate the furrow.
- Put a board indicating the name of the ciltivar, name of the pupil, date of planting and system of planting.

13.6 Observtions

(a) The pupil should record the basic data in the table given below·

Planting system	No of cuttings planted	No of cuttings survived after 30th day (sprouted)	% of survival after 30th day	No. of cuttings sprouted after 60th day
1	2	3	4	5
Pit system				
Row system				

Percentage of survival	Quantity of leaves harvested by plucking after 6 months of planting (kg)	Yield of leaves per unit area kg/Ha
6	7	8

(b) Calculate the percentage of survival of cuttings 60 days after planting
(c) Harvest the leaf per plant and calculate the yield per unit area
(d) Study the effects of planting systems on the leaf yield of mulberry

13.7 Expected Behavrioural Outcomes

The pupil will be able to:

- gain knowledge about the two systems of cultivation of mulberry;
- determine the suitability of the system,
- assess the comparative performance of the two systems;
- measure the plot and plant the cuttings as per the system.

The teacher should evaluate the pupil for the above abilities

13.8 Questions

(i) What are the pre-requisites of the row system of planting?
(ii) What planting system do you suggest for your area?
(iii) Explain why leaf yield varies according to the planting system.

ACTIVITY UNIT 14

Irrigation of Mulberry Farms

14.1 Instructional Objectives

The pupil should be able to

- understand when to irrigate, how much to irrigate and how to irrigate;
- have a clear knowledge of the soil moisture concept, namely, field capacity, wilting point, available soil moisture range;
- determine the available soil moisture;
- know the different methods of irrigation;
- understand the utility of each method,
- lay out the most common methods of irrigation.

14.2 Relevant Information

What is Irrigation?

Irrigation is the artificial application of water required for supplementing the moisture in the soil that is deficient and does not meet the full requirement of the crop

Why irrigation?

- Moisture supplied to the soil by rainfall is not always sufficient and timely.
- When irrigation is not adequate, crop growth is limited; again when water is supplied in excess, the aeration of the soil is adversely affected and the crop suffers.
- Irrigation is also needed for compensating the loss of soil moisture due to evapo transpiration.
- The plant nutrient available in the soil is dissolved in the soil moisture and made available to plants.
- Soil moisture also helps in regulating the temperature of the plant body by transpiration
- Factors affecting the quantity of irrigation water and its frequency are:

(a) Soil
(b) Climate
(c) Method of irrigation

(d) Efficiency of irrigation

- For closely spaced, low bush type of plantations, the furrow method of irrigation is adopted, whereas for wide spaced middling or tree type of plantations, the basin method of irrigation is suitable.
- Deep irrigation is required for mulberry as it is a deep-rooted crop.
- A clear understanding of the soil moisture concept is necessary before taking up any irrigation programme.
- There are three types of status of soil moisture.
  (a) The upper limit of the available soil moisture is the field capacity.
  (b) The lower limit of the soil moisture is the permanent wilting point.
  (c) The difference between the soil moisture at field capacity and wilting point level is known as available soil moisture range.
- For best growth of the plant, moisture should not be extracted at the rate of more than 60 to 70% of the available soil moisture.
- While irrigating, apply enough water to bring the soil moisture level to the field capacity

SUB-UNIT: 14.a

Determination of available soil moisture Field capacity:

14.a.3 Precautions

- Select a representative site in the field.
- Take adequate care for the prevention of evaporation from the experimental site.
- Weigh about 100 gm of soil sample carefully.

14.a.4 Materials Required

(i) A representative site in the field.
(ii) Straw mulch or black polythene sheet.
(iii) Spade.
(iv) Required quantity of water
(v) Screw or tube auger.
(vi) Moisture boxes.

(vii) Drying oven
(viii) Physical balance with weight.
(ix) Graph sheet

14.a.5 Procedure

- Select a representative spot in the field
- Ensure that the water table is not within 2 metres from the soil surface.
- In the selected plot in the field, bund an area of 2m x 2m on all four sides and remove all weeds to avoid transpiration
- Apply sufficient water to the spot so that the soil layer of 0-30 cm gets fully saturated.
- To prevent evaporation of water from the experimental plot after the area gets sufficiently wet, spread straw mulch upto 30 cm thickness If straw mulch is not available, a black polythene sheet can be used
- Take soil samples at 12 hourly intervals up to any depth of interest with an auger and determine the soil moisture at every 12 hour interval till the values of 2 successive samples are nearly equal
- Plot the reading on a graph paper The lowest reading can be taken to represent the value of field capacity of the soil.

14.a.6 Observations and Calculations

The pupil should record the following:

- Weight of the moisture box with moist soil = W_1 gm.
- Weight of the moisture box with soil after oven drying = W_2 gm.
- Weight of the empty moisture box = W_3 gm

The pupil should calculate the field capacity by the following expression

Field capacity (FC) = $W_1 - W_2 \times 100/W_2 - W_3$ (% dry weight basis)

14.a.7 Expected Behavioural Outcomes

The pupil will be able to

- determine the field capacity of the soil of an area;
- appreciate the importance of proper selection of the experimental site;
- understand the need for completely wetting the surface layer;

- know the time taken by a particular type of soil to reach the field capacity;
- understand why the field capacity of different types of soil varies.

The teacher should evaluate the pupil for the above abilities.

SUB-UNIT: 14.b

Determination of permanent wilting point (by the sunflower method)

14.b.3 Precautions

- Select the crop plant which shows clear signs of wilting for the determination of the permanent wilting point.
- It is necessary to have many replications in this experiment.

14.b.4 Materials Required

(i) Five 600 gm capacity cans with lids having four holes
(ii) Sunflower seeds.
(iii) Glass tubes (5cm × 0.5 cm).
(iv) Sealing wax.
(v) Moisture cans.
(vi) Drying ovens.
(vii) Physical balance with weight box.
(viii) Bell jars.
(ix) Water trays.
(x) Soil samples.
(xi) Sawdust.

14.b.5 Procedure

- Take the five cans chosen for the experiment with drain holes at the bottom
- Fill the cans with 500 gm of air-dried soil and then water before sowing seeds.
- Sow 4 seeds of sunflower in each can and allow them to germinate.
- After emergence, thin the plants to two per can and allow them to pass through two holes in the lid of the can
- Place the cans under insulation by keeping them in moist sawdust in order to avoid heating the cans.

- Grow the sunflower plants for about six weeks. Watering should be done as and when needed till they develop three pairs of leaves
- Insert a glass tube in the soil for aeration and plug with cotton wool.
- Water the plants for the last time, seal the soil surface and close the drainage hole with wax Then allow the plants to wilt.
- As soon as the plant show loss of turgor, trnsfer them to a dark bumid chamber. The cans with plants can be kept in a small water tray and covered with the bell jar to create a high humidity condition. The whole chamber may also be dovered with a black polythene sheet. The aim here is to close the stomata and reduce transpiration.
- Leave the plants overnight to gain favourable water balance by allowing them to extract moisture from the soil. If they gain turgidity, expose them to the atmosphere for a couple of hours and transfer them back to the humid chamber.
- Repeat the process till the plants do not recover in the dark humid chamber.
- At this stage, remove the lid and cut the plants and take a duplicate soil sample. Remove the roots. Determine the moisture content of the soil which will represent the wilting point of the soil (Fig-19).

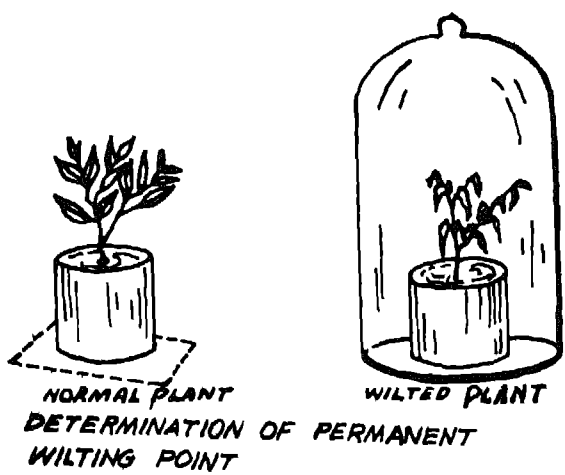


FIG 19 Determination of Permanent Wilting Point

14.b.6 Observation and Calculations

(a) The pupil should record the following:
- Weight of moisture box with moist soil (at wilting stage of the plant) = W_1 gm.
- Weight of the moisture box with soil after oven drying = W_2 gm.
- Weight of empty moisture box = W_3 gm.

Calculations:

The pupil should calculate the moisture content by the following expressions:

- Moisture content (% by dry weight) = $W_1 - W_2 \times 100 / W_2 - W_3$ (at wilting point WP).

(b) The pupil should take the values of FC and WP from sub-units 14.3.a. and b. and calculate the available soil moisture as under:

Available soil moisture = field capacity (FC) - wilting point (WP).

Available soil moisture in the profile (cm) = FC - WP × d × pb/100

Where, d = depth of soil (cm)

pb = bulk density of the soil

14.b.7 Expected Behavioural Outcomes

The pupil will be able to:
- determine the permanent wilting point of the soil.
- appreciate the importance of proper selection of plants for wilting point determination.

The teacher should evaluate the pupil for the above abilities

SUB-UNIT: 14.c

Practice in Methods of irrigation

For mulberry, the following two methods of irrigation are adopted:

(i) Furrow method (for closely spaced, low bush plantation).

(ii) Basin method (for widely spaced middling or tree plantation).

14.c.(i) FURROW METHOD -

14.c.(i).3 Precautions

- Decide the proper size and length of the furrows

- Fill up the furrows with water to wet the soil properly
- Do not allow the water to overflow the ridge top

14.c.(i).4 Materials Required

(i) Spade
(ii) Rope
(iii) Source of irrigation
(iv) Irrigation pump
(v) Irrigation pipe

14.c.(i).5 Procedure

- Label the field for laying out the furrows
- Lay out the ridge and furrows.
- Take two rows of mulberry on the raised bed and alternate these by one furrow for irrigation.
- Maintain the depth of the furrow to about 6" for deep irrigation.
- Make the ridge and furrow across the gradient of the slope if the topography of the land is sloping up to 6% gradient.
- Maintain a gentle gradient (1-2%) in the furrow for the easy flow of the irrigation water
- Apply water to fill the furrow to a depth of 4" for wetting the soil up to a depth of 2 1/2' to 3'.
- Apply water once in 8-10 days in light soil and once in 14-15 days in heavier soil (Fig-20).

14.c.(i).6 Expected Behavioural Outcomes

The pupil should acquire the ability to·

- lay out the field into ridges and furrows;
- understand why the ridges and furrow have to be laid out across the gradient in a sloping land;
- understand that there is a greater economy of water in this method.

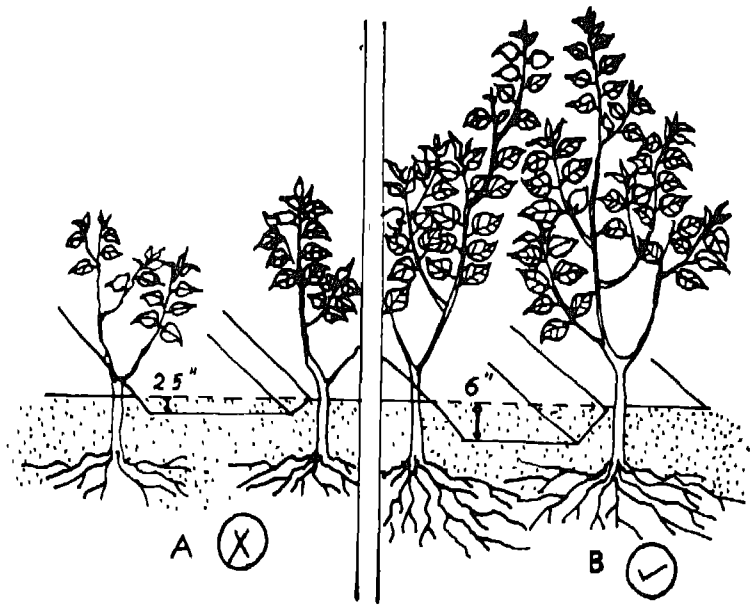
The teacher should evaluate the pupil for the above abilities.

14.c.(ii). BASIN METHOD -

14.c.(ii).3 Precautions

- Make the basin around the trunk of the tree and fill up sufficient water to wet the complete root zone of the mulberry plants (about 4"- 5").

– Connect the basin by the feeder irrigation channel after levelling it properly.



FURROW METHOD OF IRRIGATION.
A. SHALLOW CHANNEL & SUPERFICIAL IRRIGATION.
B. PROPER SIZE CHANNEL & DEEP IRRIGATION.

FIG. 20 Furrow Method of Irrigation

14.c.(ii).4 Materials Required

(i) Spade
(ii) Rope
(iii) Irrigation source
(iv) Irrigation pump
(v) Irrigation pipe

14.c.(ii).5 Procedure

– Make basins around the mulberry middlings or trees.
– Maintain the diameter of basins according to the age and size of the tree, from 1.0 to 1.5m

- Connect the basin to the feeder irrigtion channel.
- Fill the basin with water to a depth of about 6" for proper wetting of the soil up to a depth of about 5' (Fig-21).

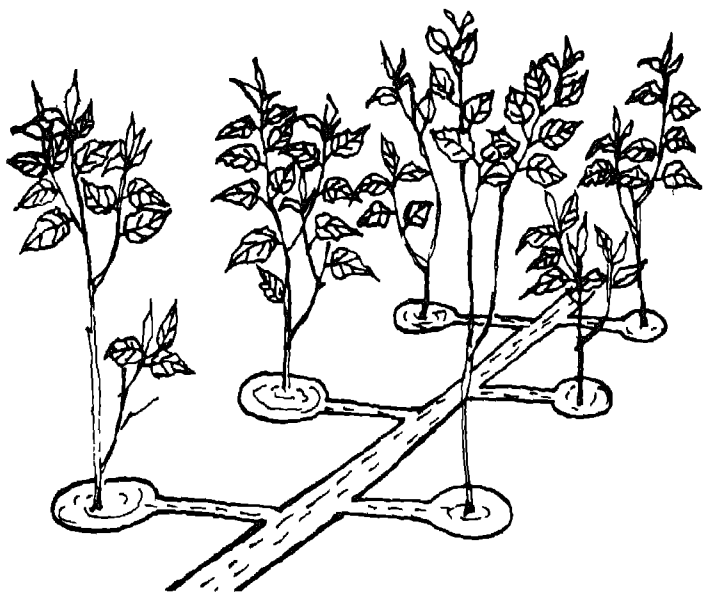


FIG. 21 Basin Method of Irrigation

14.c.(ii).6 Expected Behavioural Outcomes

The pupil will be able to:

- decide on the appropriate size of the basin;
- lay out the basin connected with the feeder channel;
- appreciate the need for proper levelling of the field before preparing the irrigation basin and channel.

The teacher should evaluate the pupil for the above abilities.

14.7 Questions

(i) What do you mean by soil moisture concept?

(ii) How will you proceed for the determination of available soil moisture range of a particular field?

(iii) What are the different methods of irrigation most commonly used in mulberry?

(iv) What are the factors to be taken into consideration for deciding the frequency of irrigation?

ACTIVITY UNIT· 15

Application of Organic Manure

15.1 Instructional Objectives

The pupil should be able to:

- understand the importance of organic manure;
- know about the various types of organic manures;
- understand the quality of farmyard manure;
- learn about the dose and method of application of farmyard manure;

15.2 Relevant Information

What is a manure?

Materials which are commonly used to supply the plant nutrients are called manures or fertilizers.

ORGANIC MANURES

These are relatively bulky materials such as animal manure or green manures which are added mainly to improve the physical condition of the soil, to make the soil suitable for development and for the activity of soil micro-organisms and also to supply a part of the plant nutrients removed by the plant.

Organic manures are classified as bulky organic manure and concentrated organic manures

Bulky organic manures. Farmyard manures, compost and green manures are some of the bulky organic manures.

Concentrated organic manures. oil cakes, fishmeal, guano, etc. They are not commonly used for mulberry.

Types of organic manure

Farmyard manure: It is the most commonly used organic manure in India. Good quality farmyard manure is perhaps the most valuable organic matter. It consists of a mixture of cattle dung, bedding or straw refuse used in the stable, mixed with cattle urine.

Careless preservation of this refuse, however, leads to the loss of nutrients from the manure. By providing absorbent bedding for cattle, storing dung in brick-lined pits, mixing straw and other vegetable matter with cattle dung, and keeping the manure heap compact and

moist, the quality of the farmyard manure will increase, and it will decompose well

Application of farmyard manure mainly provides nitrogen and also a number micro-nutrients. It also supplies organic matter to the soil. By this, the structure of clayey soil is improved and the water holding capacity of sandy soil is increased Farmyard manure increases microbial activity and the capacity of the soil to retain nutrients with a long lasting effect on soil. An average farmyard manure sample contains 1 - 1.5% of nitrogen, 0 5 - 0 8% of phosphorus and 0.5 - 1.5% of potash.

Well decomposed farmyard manure is brownish-black in colour, powdery and without the smell of fresh dung

For mulberry, 10 tons of farmyard manure for the rainfed crop and 20 tons of farmyard manure for the irrigated crop are recommended for one hectare of mulberry garden per hectare/yr.

15.3 Precautions

The following types of farmyard manure are to be avoided:

- which is mixed with too much soil,
- which is too wet;
- which is not completely decomposed;
- which has straw, leaves, etc and in which cow dung etc. can be seen clearly.

Farmyard manure should not be spread out and stored in the open. It must be piled into a heap and covered with mud plaster. While applying farmyard manure, it should not be allowed to remain on the surface. It must be well mixed with the soil.

15.4 Material Required

(i) Well decomposed farmyard manure.
(ii) Iron pans or cane baskets.
(iii) Spades and Kuddali
(iv) Balance with weights or spring pan balance.

15.5 Procedure

- Calculate the dose of farmyard manure required for your plot on the basis of 10 and 20 tonnes per hectare dosage
- = Dosage per hectare x area of the plot in metres /10,000
- Weigh the quantity of required manure.
- Take the weighed manure in a basket.
- Apply to the plant. For the pit system, apply around the plant.

For the row system apply, between the rows.

- Mix the manure into the soil well with the Kuddali.

15.6 Observations and Calculations

- After one month, record the height and number of leaves of 10 plants selected at random to which different doses of farmyard manure were applied;
- Collect 100 gm of soil from three plots, weigh them, dry in an oven at 100^{0}C for 25 hours and again weigh them. Calculate the water content on dry weight basis;
  ie Fresh wt - dry weight x 100/Dry weight
- See whether the soil receiving more manure has more water content.
- Find out the cost of the farmyard manure per tonne and calculate the cost of manure per hectare.

15.7 Expected Behavioural Outcomes

The pupil will be able to:

- learn about the proper method of applying farmyard manure;
- assess the effect of farmyard manure on mulberry plants;
- calculate the required dose of manure

15.8 Questions

(i) Why should farmyard manure be mixed into the soil?

(ii) How does farmyard manure application increase the water holding capacity of the soil?

ACTIVITY UNIT· 16

Application of Green Manures

16.1 Instructional Objectives

The pupil should be able to:
- know about the various green manure crops,
- know the time of incorporation of the green manure crop;
- know the method of applying green manure crops

16.2 Relevant Information

Growing a crop and incorporating green foliage into the soil is called greeen manuring. Leguminous crops are commonly used for green manuring as they fix atmospheric nitrogen and add nitrogen to the soil in addition to organic matter.

Green manure crops are ploughed into the soil when they are about to flower, if allowed to grow longer, the green manure crop will decompose slowly. When there is sufficient moisture in the soil, the green manure crop decomposes quickly.

Green manure crops promote the activity of soil micro-organisms, increse the chemical action of the soil, and plant food is made available. They improve the strcuture and water holding capacity of the soil. They also reduce the presssure on farmyard manure for which there is a great demand in agriculture.

The commonly used green manure crops in mulberry plantation are Sannhemp (*Crotolaria juncea*), Horsegram (*Dolichos biflorus*) and Dhaincha (*Sesbania aculeata*).

16.3 Precautions

- Do not select old green manure seeds.
- Select viable seeds.
- Sow the seeds when the soil moisture is adequate.
- Do not sow seeds very thinly.
- Incorporate before the crops flower and when there is enough soil moisture.

16.4 Materials Required

(i) Kuddali
(ii) Rake
(iii) Green manure seeds
(iv) Rhizobial culture
(v) Sickle
(vi) Spade
(vii) Watering can or pot

16.5 Procedure

- Dig the soil and break the clods.
- Treat the green manure seeds with Rhizobial culture.
- Sow the green manure seeds by broadcasting, at the rate of about 35 kg of seed per hectare when there is enough moisture in the soil.
- Stir the soil to mix the seed in it.
- After the green manure crop grows and flower buds have been formed and the occasional flower has opened, cut the green manure plants, make sure that there is enough moisture in the soil.
- Dig the plot.
- Make trenches 22 cm to 30 cm deep between the mulberry plants.
- Put the green manure plants in the trench and cover with soil.

16.6 Observtions

- Find out the number of days required for germination of the green manure seeds.
- Calculate the number of days from sowing to the date of flowering.
- Pull out a few plants and observe the number of nodules on the root.
- After cutting the green manure plants from 1 metre x 1 metre, weigh the plants.
- Estimate the green manure crop per hectare.
- After putting the green manure plants in the trench, find out the number of days required for the decomposition of (i) leaves (ii) and the whole plant.

16.7 Expected Behavioural Outcomes

The pupil will be able to:

- understand the importance of green manure on the growth and development of mulberry;
- know about the various types of green manures;
- know the method of growing and incorporation of green manure;
- learn about the time of application of green manure.

16.8 Questions

(i) What is green manuring? Describe step by step how will you prepare green manure

(ii) Why should we incorporate the green manure crop before flowering?

(iii) Why should the soil moisture be adequate for incorporation of green manure?

ACTIVITY UNIT 17

Preparation of Compost

17.1 Instructional Objectives

The pupil should be able to

- know the materials that can be used for composting,
- know the actual method by which the plant residues are converted to compost,
- understand the changes in temperature and the gaseous reaction taking place during composting;
- know the precautions to be taken so that the quality of the compost is not lowered.

17.2 Relevant Information

Compost making is the process of decomposing plant residues in a heap or a pit, to bring the plant nutrients in a more readily available form. If these plant residues are applied directly to the soil without decomposition, they are likely to be injurious to the crop Composting is also useful in converting harmful waste products like sewage into a product that is safe to handle and use Compost resembles ordinary farmyard manure in appearance, properties and manurial value.

There are different methods of composting based on whether the proces is anaerobic (without air) or aerobic (in the presence of air).

The residues usually used in compost have a carbo-nitrogen ratio of 40 to 1 which is reduced to 10-12 to 1 after composting. If this ratio is very wide, the micro-organisms take more time to decompose the material as they need some nitrogen to start with. That is why cow dung, urine,green leaves or green manures or even a small quantity of nitrogen fertilizer are added.

In this method (Bangalore method), the decomposition at first is aerobic, raising the temperature, then the decomposition is semi-aerobic and slows down. The compost will be ready in about six months.

Utility:

Weeds, plant residues, sweepings of rearing houses including the litter can be converted to compost and applied to mulberry fields to partially meet the manurial requirements and help reduce the cost of inputs.

17.3 Precautions

- Do not use only dry, hard twigs.
- Green materials that are too succulent like banana stems etc. are to be allowed to wilt for a day or two before using.
- The site selected for the trench should be at a high level
- Do not use too much water.
- The cracks appearing in the dome should be sealed with mud plaster

17.4 Materials Required

(i) Trench, 10 feet long, 3 feet deep and 4 feet wide. The sides should be sloping with the dimensions at the bottom less by 6" and with a sloping floor
(ii) Vegetable wastes – like weeds, fallen leaves, green leaves, tender branches, and rearing wastes, etc
(iii) Soiled bedding from the cowshed
(iv) Cow dung, wood ashes.
(v) Water pots.
(vi) Water.
(vii) Sickles to cut the plant materials.
(viii) Baskets.
(ix) Clayey soil – about a cartload.
(x) Spade to dig the trench.

17.5 Procedure

- Collect the plant material and stack it near the trench.
- Chop them if they are too long.
- Spread the plant material in the trench upto 6" height.
- Mix the cow dung and wood ash with water and make a slurry.
- After every six inches height of plant material sprinkle the slurry over the layer.
- Sprinkle water to wet the material.
- Repeat the layer of plant material and cow dung slurry.
- Fill the pit with material one foot above ground level
- Make the top dome-shaped

- Mix the soil with water and make it into a paste.
- Plaster the top of the pit with soil about 1" thick.

17.6 Observations

- After about one week, open the mud plaster a little near the base of the dome. Feel the temperature with your hand.
- Insert a thermometer and find out the temperature inside the dome. Take out the thermometer and read the temperature of the air. Find out the increase of temperature inside the dome. Seal the hole with mud plaster again.
- Find out the temperature again after one month in the same way – has the temperature increased or decreased?
- Can you smell any gas?
- After three months, open the dome partly and find out whether the plant materials have decomposed.

17.7 Expected Behavioural Outcomes

The pupil will be able to:

- learn the technique of composting;
- utilize farm and rearing wastes in a better way;
- understand the utility of compost.

17.8 Questions

(i) What is the utility of compost?
(ii) How do you prepare compost?
(iii) What is the principle to convert green matter into manure?
(iv) Why does the carbon-nitrogen ratio decrease after composting?

ACTIVITY UNIT: 18

Fertilizers and their Uses

18.1 Instructional Objectives

The pupil should be able to:

- know about the types of fertilizers;
- identify the common fertilizers,
- understand about straight or complex fertilizers, grade, etc.;
- calculate the quantity of fertilizer required to supply the required amount of nutrients;
- understand the method of application of the fertilizers to the plant

18.2 Relevant Information

What are fertilizers?

Fertilizers are inorganic materials of concentrated nature and are applied to the plants to increase the supply of one or more essential plant nutrients, e.g. nitrogen, phosphorus and potash. Accordingly, they are called nitrogenous fertilizer, phosphatic fertilizer or potassic fertilizer. Fertilizers which contain only one nutrient are called straight fertilizers and those which have two or more plant nutrients are called complex fertilizers.

Fertilizers are also commonly known as chemical or artificial manures

Why use fertilizers?

The available quantity of farmyard manure or compost is insufficient to meet the needs of the crops and fertilizers have to be used to supplement the nutrients to the plants. Fertilizers have the advantage of smaller bulk, are concentrated and easy to transport. They also have the nutrients in a quickly available form and are quick acting.

Common fertilizers

The most commonly used nitrogenous fertilizers are urea which contains 45-46% nitrogen, ammonium sulphate which has about 20% nitrogen; and calcium ammonium nitrate which contains 25-28% nitrogen.

The common phosphatic fertilizer is single super phosphate containing 16% P_2O_5.

Potassium chloride and potassium sulphate are common potassium fertilizers containing 60% and 48% K_2O respectively.

Compound fertilizers like ammonium phosphate contain both nitrogen and phosphorus. Complex fertilizers are available with all the three elements in different concentrations. The commonly available grades are 15:15:15, 17:17:17 and 19:19:19.

The grade of the fertilizer indicates the percentage of plant nutrient in the fertilizer.

Nowadays, complex fertilizers are becoming popular and by a combination of complex and straight fertilizers, the recommended quantities of plant nutrients are applied to the crop. Phosphorus and pottassium are applied once or twice a year but nitrogen is applied in more doses, as nitrogen can be lost by leading.

How much fertilizer to apply?

The quantity of plant nutrients to be applied depends upon the crop, the dry matter produced, the system of cultivation, the natural fertility of the soil and the availability or deficiency of the nutrient in the soil, whether the crop is irrigated or rainfed, etc. The research institutes conduct experiments and recommend the amount of nutrients to be applied to the crop, time of application and number of doses, etc. Based on this information, fertilizers are applied to supply the required quantity of nutrients.

Fertilizer for mulberry

The research institutes recommend 300 kg of nitrogen, 120 kg of phosporus and 120 kg of potash per hectare of irrigated mulberry.

For rainfed mulberry, 100 kg of nitrogen, 50 kg of phosphorus, 50 kg of potash per hectare are recommended. The details are given below:

	Irrigated mulberry N P K	*Rainfed mulberry* N P K
(a) Recommended dose (kg) per hectare	300 - 120 - 120	100 - 50 - 50
per acre	120 - 48 - 48	40 - 20 - 20
(b) To be applied in	Five split doses, one dose after each crop.	Two doses: one after pruning and one after the first harvest.

(c) Quantity of nutrients for each dose (per acre)**	I dose 24 - 24 - 24	20 - 20 - 20
	II dose 24 - 0 - 0	20 - 0 - 0
	III dose 24 - 24 - 24	(After the rains
	IV dose 24 - 0 - 0	when there is
	V dose 24 - 0 - 0	sufficient soil moisture)
	Total 120 - 48 - 48	40 - 20 - 20

	Irrigated	Rainfed
(d) Quantity and type of fertilizer to be applied to one acre to provide the above nutrients.	I dose 160 kg of 15-15-15 or 140 kg of 17-17-17 (complex)	133 kg of 15-15-15 or 120 kg of 17-17-17 (complex)
	II dose Urea - 53 kg or ammonium sulphate 120 kg	Urea - 45 kg or 100 kg ammonium sulphate
	III dose 160 kg of 15-15-15 or 140 kg of 17-17-17 (complex)	----
	IV dose Urea - 53 kg or ammonium sulphate 120 kg	----
	V dose Urea - 53 kg or ammonium sulphate 120 kg	----

(** - For hectare: multiply by 2.5)

18.3 Precautions

- Use a fertilizer which has been stored in a dry condition.
- Do not use fertilizer which have become soggy or have absorbed moisture.
- Lable the fertilizer properly
- Know the grade of the fertilizers as given on the packing and use it for calculation purposes.
- Do not handle the fertilizer with wet or moist hands.
- Do not apply fertilizer when it is raining.
- Ensure that there is adequate moisture in the soil when fertilizers are applied.

- Irrigate the plot well, 2-3 days before the application of the fertilizer.
- Do not apply fertilizers on the soil surface.
- Do not mix urea with super phosphate. If mixed with ammonium sulphate or muriate of potash, use immediately.
- Apply fertilizers after leaf harvest and not when the leaves are ready for harvest.
- Preserve the remaining stock of fertilizers in dry conditions.

18.4 Materials Required

(i) Fertilizers
- Urea
- Ammonium sulphate
- Calcium ammonium nitrate
- Single super phosphate
- Muriate of potash
- Complex fertilizers of 17-17-17
- Complex fertilizers of 15-15-15

(ii) Balance to weigh the fertilizers

(iii) Kuddali for digging

(iv) Iron pan for transporting fertilizers

18.5 Procedure

- Calculate the quantity of urea, ammonium sulphate, calcium nitrate or complex fertilizer to supply nitrogen to 100 sq.m. at the rate of 60 kg nitrogen per hectare using the formula:
  A x 100 x C / B
  A = Quantity of nutrient to be applied to one hectare
  B = Composition of the nutrient in the fertilizer
  C = Area to which fertilizer is to be applied (hectares)
- Similarly, calculate the quantity of super phosphate or muriate of potash to supply 50 kg of P205 or K20/hectare required for 100 sq.m
- Weigh the required quantity of fertilizer.
- Dig the soil around the plant.
- Apply the fertilizer to the plants which are in 100 sq.m. area.
- Dig again so that the fertilizer is mixed into the soil.

18.6. Observations

- Compare the growth and colour of the leaves, feel the succulency of the leaves, after one month.

- Observe after one week whether the fertilizer granules are still present in the soil or have dissolved
- Observe the major types of fertilizers, their physical form so that, you can identify fertilizers like urea, ammonium sulphate, super phosphate and muriate of potash and record in the following table·

Name of fertilizer	Nutrient	Grade	Colour	Form (granule, or powder etc)	Feel (wet/dry /waxy)

- Assess the leaf yield after each harvest and calculate the annual yield.

18.7 Expected Behavioural Outcomes

The pupil will be able to:

- understand the role of different fertilizers;
- know the dose and mode of application of fertilizers;
- know the calculation of fertilizers to supply required quantity of the nutrient;
- to study the effects of fertilizers on growth, development and yield of mulberry.

18.8 Questions

(i) What are the fertilizers commonly used for mulberry?

(ii) What is the difference between straight and complex fertilizers? Why are complex fertilizers popular?

(iii) What are the doses and mode of application of different fertilizers for irrigated and rainfed mulberry plantations?

(iv) How do you preserve fertilizers?

ACTIVITY UNIT· 19

Pruning Methods

19.1 Instructional Objectives

The pupil should be able to:

- understand the principles and objectives of pruning;
- know the physiology of pruning,
- know the different systems and frequency of pruning with respect to different type of mulberry cultivation followed in different parts of India.

19.2 Relevant Information: Principle and objectives of pruning

What is pruning?

Pruning is the methodical removal of certain branches of the mulberry plant with the objective of giving the plant a convenient shape and size to increase the leaf yield and improve its feeding quality.

Why is mulberry pruned?

In mulberry, pruning is practised solely to improve the yield of foliage and to maintain the shape and size of the plant for easy and early harvest of suitable quality leaf for silkworm rearing.

Pruning of mulberry is also useful in adjusting the production period of the mulberry leaf to synchronize with the silkworm rearing period.

Pruning is one of the cardinal principles of mulberry leaf production technology.

Pruning of the plant into some definite cut form is also essential for easy intercultural operations.

By following the proper schedule and method of pruning, it is possible to get 2-3 harvests in temperate regions, and 5-6 harvests in tropical regions.

Different pruning schedules are followed depending on the nature of cultivation and climates such as rainfed, irrigated and temperate regions.

Physiology of pruning

The main idea of pruning mulberry is to take advantage of apical

dominance. When a plant is pruned at a particular height, the buds below the cut end get physiologically invigourated and healthy shoots bearing twigs and succulent leaves are regenerated. In other words, breaks the dormancy of the buds and induces development

Calculation of leaf area

The leaf area can easily be determined by drawing the exact outline of the leaf on a piece of graph paper. The complete squares are counted. Wherever the leaf margin covers more than half of the small square, it is taken as a complete square and wherever it is less than half, it is ignored. The sum of the squares gives the leaf area

19.3 Precautions

- Carry out the pruning operations very carefully without peeling the bark or splitting the wood at the cut ends, since this leads to failure of regeneration of dormant buds into healthy branches.
- Prune mulberry only with a sharp pruning saw or sickle.
- Do not use blunt implements for pruning as these will injure the mulberry stumps, leading to the death of the plant.
- Do not prune mulberry towards the end of the monsoon period or during soil moisture stress periods where mulberry is cultivated as a rainfed crop.

19.4 Materials Required

(i) Pruning saw
(ii) Pruning sickle
(iii) Secateurs
(iv) Tree pruners
(v) Bill hook
(vi) Labels

19.5 Procedure

Pruning under rainfed conditions

- Prune mulberry plants once a year at the onset of monsoon.
- Use a sharp pruning saw or sickle.
- Prune plants at a height of 10-15cm from the ground.
- Remove thin and weak lower branches to divert more plant energy for effective tillers.

Pruning under irrigated conditions
(when shoot harvesting is practised)

- Make 5-6 sharp harvests annually which combine with pruning.

- The pruning operation has to be carried out with a sharp pruning saw or sickle.
- Prune the plant at height of 10-15cm from the ground level at the time of each rearing.

Pruning for temperate regions

- Prune mulberry plants in March before the buds sprout for harvesting the mulberry leaves for the summer and autumn rearings.
- Prune during May/June after the leaf harvest for the spring rearing. It will provide a harvest for autumn or the next spring rearing.
- Prune the shoots at the base of the crown of the middling or dwarf plants.

19.6 Observations

- Record the date of pruning.
- Observe the date of sprouting of dormant buds.
- Record the length of shoots and number of leaves of fine shoots at random.
- Compare the leaf area of pruned and unpruned plants taking ten leaves each at random.

19.7 Expected Behavioural Outcomes

The pupil will be able to:

- understand the principles of pruning;
- know the systems of pruning for different agro-climatic regions of India;
- take care of plants during pruning,
- prepare pruning schedules for production of leaf synchronizing with the silkworm rearing.

The teacher should evaluate the pupil for the above abilities.

19.8 Questions

(i) What do you understand by pruning and why is it necessary?
(ii) What are the different reasons and frequency of pruning for mulberry in different agro-climatic regions of India?
(iii) What precautions will you take in pruning?
(iv) Do you observe any differences in leaf size and quality between the pruned plant and unpruned one? If so, make a list of these.
(v) Pruning accelerates the growth of the mulberry plant. Explain.

ACTIVITY UNIT: 20

Weeds and their Control

20.1 Instructional Objectives

The pupil should be able to:

- identify the common weeds found in mulberry field;
- know the time of weed control;
- know the different methods of weed control.

20.2 Relevant Information

What are the weeds?

Weeds are those plants which grow where they are not wanted.

Why do weeds have to be removed?

Weeds compete with mulberry plants for water, nutrient, light and space and reduce the yield of mulberry leaves. Weeds also harbour insect pests and diseases and some are poisonous or harmful to man and animals. Some weeds are parasitic. Weeds increase the cost of cultivation and reduce the quality of the mulberry leaf. Weeds are known to reduce mulberry leaf yield upto 65%.

Weeds are hard, grow fast, flower early and produce seeds in profusion. Weed seeds in general do not lose viability for a year and can germinate after years.

Classification of weeds

Weeds are generally classified into broad leaved (Dicotyledon) or narrow leaved (Monocotyledon) plants. They are also classified as annuals, biennials or perennials. Annuals propagate mostly through seeds, but perennials propagate both by seeds and by vegetative parts like the rhizome, etc. If the weeds are cut or severed when they are being removed, the remaining portions continue to grow

Common weeds of mulberry gardens:

The most common weeds of mulberry fields are:

(i) *Cynodon dactylon* It is also called Hariyali or Doob grass. It is a very troublesome perennial grass, deep rooted with underground rhizome and is difficult to eradicate (Fig-22).

(ii) *Cyperus rotundus*: Also called nutgrass though it is not a grass.

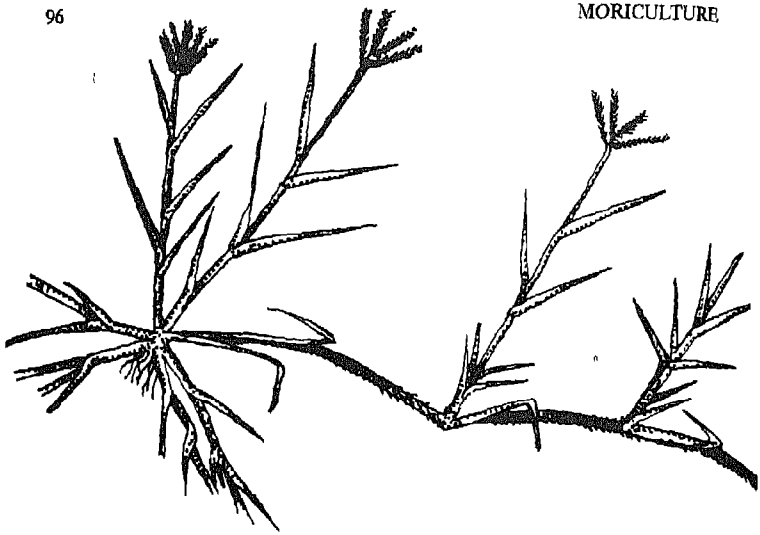


FIG. 22 Cynodon Dactylon Pers Bahama Grass or Harıyalı

It is perennial and its stolons are found very deep in the soil. Difficult to eradicate (Fig-23).

(iii) *Lagasea mollis:* Broad leaved weed (Fig-24).

(iv) *Tnanthema portulacastrum*: Spreading broad leaved perennial. When pulled out, breaks easily. Propagation both by seeds and vegetative means.

(v) *Other weeds: Phyllanthus niruri, Euphorbia hirta,* (Fig-25). *Corchorus* sp.

Control of weeds

Weeds are controlled:

(a) Mechanically, by pulling out by hand or ploughing

(b) Chemically, by spraying weedicides

(c) By biological methods using insects or other plants

The most common way of controlling weeds is by the use of hand weeding implements or by using a cultivator or plough. Weed control will best be achieved by removing the weeds before they flower. If the farmyard manure applied is not fully decomposed, it may be a carrier of weed seeds. The chemical method of weed control is not yet very popular in mulberry cultivation Chemicals used to control weeds are called herbicides or weedicides. A number of chemicals are used and the most commonly used ones are, 2,4-D, Dalapon Grammoxone (paraquat), Karmex (Diuron) etc. Chemicals which can kill only a few

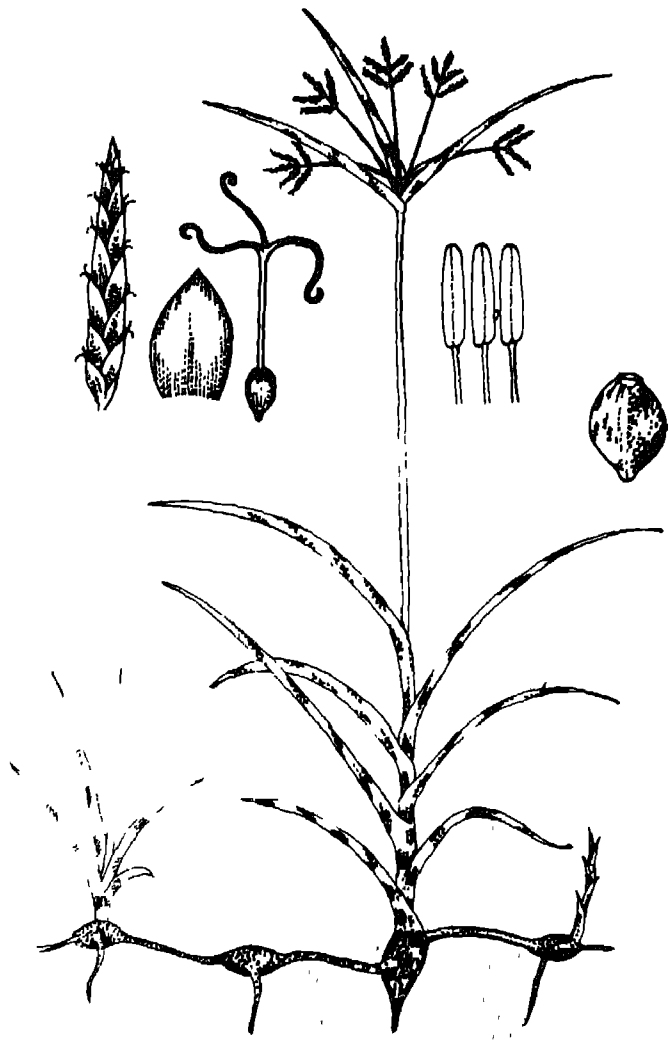


FIG 23 Cyperus Rotundus Nutgrass Nutsedge

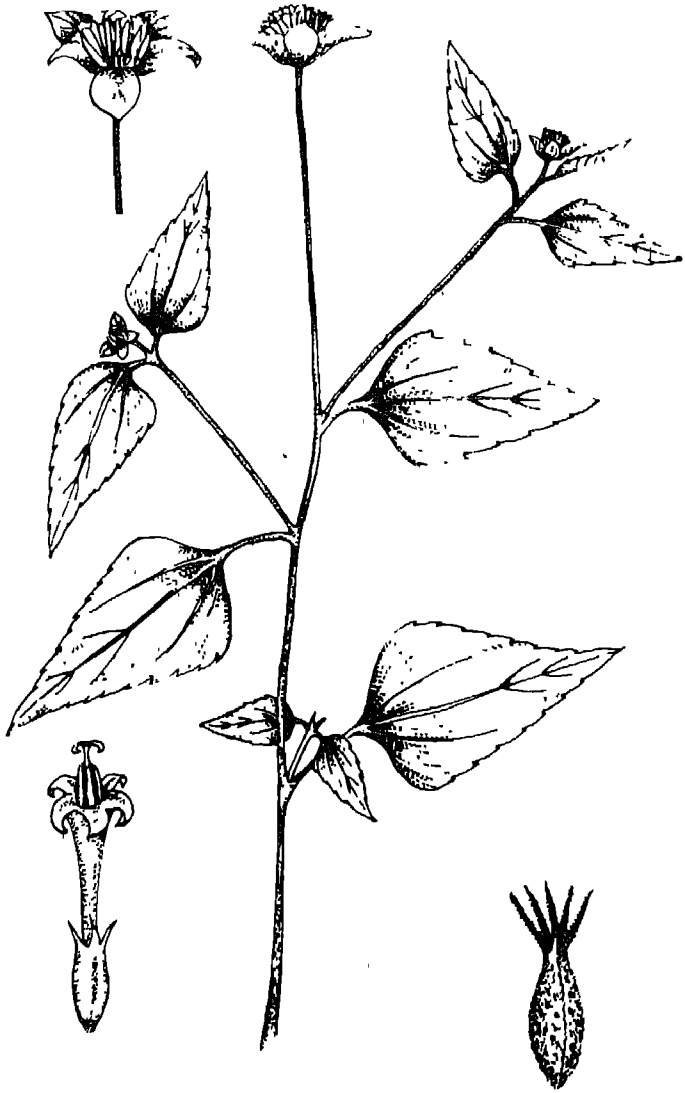


FIG 24 Lagascea Mollis Cav

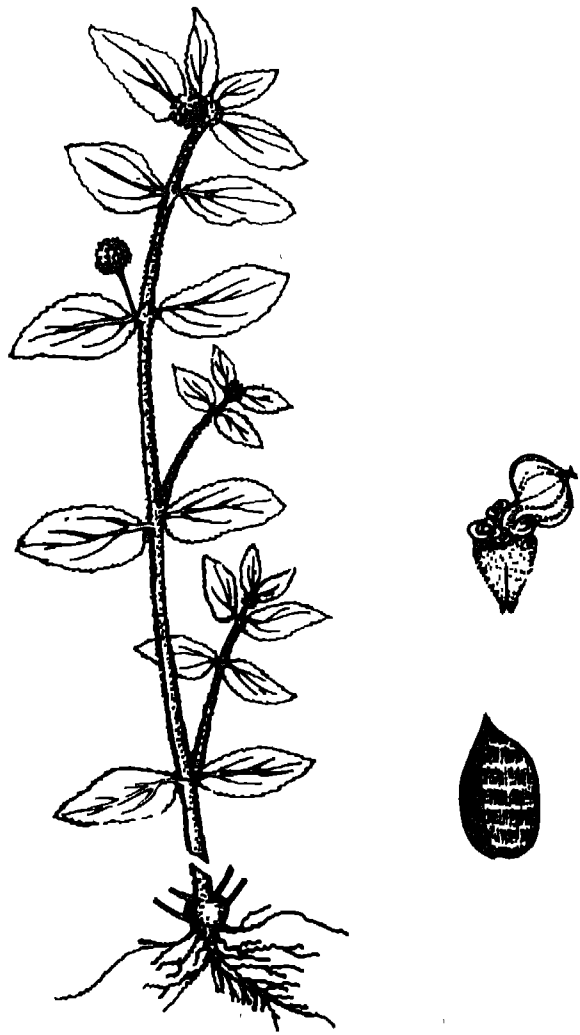


FIG. 25 Ephorbia Hirta

types of weeds are called selective herbicides: 2,4-D kills only dicot weeds. Grammoxone kills all plants and is called a non-selective herbicide.

To minimize injury to the mulberry plants, herbicides are applied when the mulberry plants have been pruned or after the leaf harvest.

This Activity Unit should be performed through the following sub-units: Mechanical weed control, Chemical weed control.

SUB-UNIT: 20.a

Mechanical Weed Control

20.a.3 Precautions

- Do not allow the weeds to flower. Remove them before flowering.
- Remove the weeds with roots.
- The soil should not be dry or have too much moisture. The soil should be easy to work with.
- While using bullocks for weeding, the mulberry plants should not be damaged.
- Use bullocks in the pit system of plantation.

20.a.4 Materials Required

(i) Herbarium specimens of common weeds
(ii) Kuddali or fork
(iii) A pair of bullocks with blade harrow or cultivator
(iv) Blank herbarium sheets
(v) Herbarium press

20.a.5 Procedure

- With the help of a Kuddali, dig the soil and remove the weed.
- Separate the different type of weeds.
- Count the types of weeds.
- With the help of herbarium specimens, identify the weeds, their common and Latin names
- Mount one good complete specimen of the weed on the herbarium paper, write the common and Latin name and keep it in the press
- Draw the bullock with the harrow in the mulberry row.

– Check how many weeds are removed with roots and how many are cut and therefore without roots

20.a.6 Observations

– Measure 0 5metre × 0 5metre in the row, remove the weeds and calculate the number of weeds per sq.m.
– Find out how many of the weed plants are broad leaved and how many are narrow leaved.
– Identify the weeds, how many species are found?
– In the case of nutgrass (*Cyperus rotundus*) remove soil carefully, and observe the nuts in the ground. Observe how they are connected, to what depth the nuts are found and the number of nuts per plant.
– Observe in the case of Harıyali (*Cynodon dactylon*), how the plant is spreading.
– Tabulate the findings in the following way:
  (a) Total number of weeds / sq.m. (weed density)
  (b) No. of species
  (c) No. of broad leaved weeds
  (d) No of narrow leaved weeds
  (e) The species most common
– Find out the time taken to weed one row by mannual digging as compared to bullock harrowing

20.a.7 Expected Behavioural Outcomes

The pupil will be able to.
– know the mechanical methods of weed control;
– know about common weeds found in mulberry fields,
– assess the density of the weeds,
– identify the main features which make the weed more competitive,
– determine the best time to control weed.

20.a.8 Questions

(i) What are the common types of weeds that occur in mulberry feeds in your area?
(ii) Why is it difficult to control nutgrass or Harıyali?
(iii) Why is it necessary to remove weeds before they flower?

SUB-UNIT. 20.b

Chemical Weed Control

20.b.3 Precautions

- Apply the chemical only when the mulberry is pruned or after leaf harvest. If leaves are present, the chemical may fall on the leaves and damage the plant
- The chemical is to be sprayed at a lower level on the weed plants and not on the mulberry plants.
- The spraying is done when there is not much wind.
- While mixing the chemicals do not handle with bare hands, do not smoke or chew pan while handling chemicals. Wash handswell with soap afterwards.
- Use the correct nozzle for the sprayer so that a fan-spray is given out and provide a hood above the nozzle.
- Where there is heavy growth of weeds, slash the weeds first
- The chemical is best applied when the weeds are in the active growth stage.

20.b.4 Materials Required

(i) Grammoxone herbicide - 1/2 litre
(ii) Glass measuring cylinder of one litre capacity
(iii) Plastic buckets - 2 with mugs
(iv) Knapsack sprayer with a fan type nozzle, and also with a hood
(v) Water

20.b.5. Procedure

(For spraying half acre (0.2 hectare))

- Measure Grammaxone, in the measuring cylinder. Take 500 ml of the chemical.
- Mix the chemical with 100 litres of water and stir well with the stick.
- Pour the solution into the sprayer tank.
- Fit the sprayer on your back and operate the handle.
- Spray the solution at low volume on the ground.
- Cover the weed plants with the spray solution and keep walking slowly in the row.
- Keep the spray nozzle about 1 1/2 feet above ground and spray only on the weed plant.

- After spraying, wash the sprayer and tank. Pour clean water in the tank and operate the sprayer till the chemical is removed.
- Repeat the spray after the next leaf harvest.

20.b.6 Observations

Before spraying

From an area of 1 sq.m. find out the different types of weeds present and their population.

- 3 days after spraying, find out the effect of the chemical on the weed plants. Note the number of weed plants killed
- After 15 days repeat the observations and note the no. of plants regenerating.
- After 2 applications, count the number of weeds and note in the following table:

	Total no. of weeds plant/sq m	No of broad leaved weeds	No of narrow leaved weeds
Before spraying			
After one spray			
After two spray			

List out the names of the weeds not affected by the chemicals or those which regenerate quickly.

- Calculate the cost of the chemical used per acre.
- Note the chemical name of Grammoxone .

20.b.7 Expected Behavioural Outcomes

The pupil will be able to:

- control weeds by the use of chemicals;
- handle the chemicals, know the precautions to be taken and use the chemicals in the proper way;
- understand the effect of chemical on different type of weeds;
- workout the economics of chemical weed control.

20.b.8 Questions

(i) What is the action of the chemical on weeds?

(ii) After 2-3 applications, the quantity of chemical required is reduced. Why is it so?

(iii) Why should we spray the chemical on weed when they are growing vigorously? Why should we cut the weeds if they have grown too much?

ACTIVITY UNIT 21

Leaf Harvesting

21.1 Instructional Objectives

The pupil should be able to:

- appreciate the importance of leaf harvest;
- judge the best time of harvest,
- know the methods of harvesting leaves in relation to the stage of silkworms.

21.2 Relevant Information

(a) Harvesting methods

The method of harvesting mulberry weeds depends on the rearing practices. The leaves are fed either in cut bids or the entire shoot/branch is fed. Depending on the method of feeding, the leaves are harvested; this also depends on the availability of labour.

There are three methods of harvesting mulberry leaves·

(i) leaf picking
(ii) branch cutting
(iii) whole shoot harvesting

Leaf picking: The leaves are picked individually from the bush and the terminal bud is removed This accelerates growth of the auxiliary buds, thus, allowing laterals shoots to develop For the second crop the leaves from the lateral shoots are harvested. The tender leaves are fed to the young silkworms and more mature leaves to the silkworms of later stages. This is quite a laborious procedure In India, harvest are made 5-6 times a year and in many places this system is followed. In India, the leaf picking starts about 10 weeks after bottom pruning and subsequent pickings are at an interval of 7-8 weeks. Thus, 6-7 crops are harvested after which the bushes are pruned to the ground level.

Branch cutting: In this method, the entire branch with the leaves is cut and fed to the worms after the III moult This method is practised in Kashmir, West Bengal and parts of Karnataka. The advantages of this system are:

(i) it is easy in low and medium bush plantations,
(ii) it saves labour and collection of leaves, distribution of feed, changing of bed and spacing;
(iii) the leaves do not wither fast, thereby retaining the leaf moisture and succulancy longer for the silkworms,
(iv) Since the branch rearing is practised on a shelf or on the floor, rearing equipments like trays, shelves, etc. are dispensed with;
(v) it helps in maintaining hygenic conditions in rearing the silkworms,
(vi) it results in maximum utilization of leaves as they remain fresh for a longer time.

Whole shoot harvest: This system is adopted in Malda District in West Bengal and Kolar District in Karnataka The top half is normaly fed to the silkworms in the IV age and the rest is for mature larvae. The branches are normally cut close to the ground level in the V age. The topping helps in uniform maturity of the leaves still on the plants. Thus, the energy which would have otherwise been utilized by the formation of new leaves would be available for the leaves left on the branches making them more uniformly mature. The shoots are generally harvested at an interval of 10-12 weeks obtaining 4 - 5 harvests per annum This is suitable where leaves sprout throughout the year.

Harvesting methods are adopted depending on the system of rearing and the availability of labour

(b) Time of harvest

The quality of leaves is affected to some extent by how quickly the leaves wither Therefore, the time of harvesting in the day influences the length of time for which the leaves can remain quality feed. The fresher the leaves, the better the feed value. Efforts should be made to harvest quality leaves and keep them fresh for a longer period. Due to active photosynthesis and transpiration during daytime, leaves harvested late in the afternoon contain comparatively less water and more carbohydrates and such leaves wither more rapidly than the leaves harvested in the early morning. It is, therefore, generally recommended that the leaves be harvested in the morning hours.

21.3 Precautions

- Find out about the type of cultivation and rearing methods in order to adopt a suitable harvesting system.
- Harvest leaves before noon.

- Find out the suitability of leaves for the age of silkworms under rearing and then plan the harvest.
- Use a sharp instrument for branch cutting.
- Harvest the shoots one by one to avoid damage to the plants.
- Do not allow the leaves to wither after harvesting.
- Transport them immediately to the place of storage preferably in a wet gunny/cloth bag.
- Do not harvest more leaves than required.
- Do not damage the plants while plucking the leaves.

21.4 Materials Required

(i) Leaf basket with gunny cloth
(ii) Weighing scale
(iii) Cart for transporting leaves to the rearing house
(iv) Sharp instruments to cut branch/shoot

21.5 Procedure

- Find out about the type of plantation.
- Find out about the method of rearing.
- Find out the age of the silkworms.
- Ascertain whether the leaves are suitable for the age of the larvae.
- Calculate the approximate quantity of leaves required.
- Pick the leaves suitable to the age of the larvae.
- Use a sharp instrument while harvesting the shoots.
- Use a gunny bag for loose leaves and gunny cloth for the shoot harvest.
- Take the weight of leaves or whole shoots and record it.
- Transport the leaves within a short period using a cart whenever necessary.
- Store the leaves in a cool place duly covering the same with a wet gunny cloth.
- Harvest twice a day i.e. once at 9 A.M. and again at 4 P.M.
- Keep the premises where leaves have to be stored clean

21.6 Observations

The pupil should observe:

- the type of mulberry plantation;
- the type of harvesting needed;
- the suitability of leaves for silkworm rearing;

- the means of transport of harvested leaves/shoots to the rearing house;
- whether the leaf basket has a wet gunny cloth cover;
- whether the instrument used in shoot harvest is sharp enough not to damage the shoots;
- record the time of harvest;
- record the quantity of leaves harvested.

21.7 Expected Behavioural Outcomes

The pupil will be able to:

- know the various methods of leaf harvesting;
- know the optimum time to harvest leaves;
- know the importance of wet gunny bag/cloth in the transportation and preservation of mulberry leaves;
- understand the capacity of the leaves to retain moisture in the different methods of storage,
- understand the importance of harvesting and preserving leaves for obtaining a good silkworm crop.

21.8 Questions

(i) Describe different methods of harvesting mulberry leaves, their advantages and disadvantages

(ii) Explain the various methods of harvesting adopted in different parts of India. What is their relevance to local conditions?

(iii) Explain the means adopted for safe transportation and storage of mulberry leaves.

(iv) Why should the leaf picking system not be used in silkworm rearing adopting the shelf rearing technique?

(v) Which is the best time for harvesting mulberry leaves and why?

(vi) Is the withering of mulberry leaves faster in leaf picking or shoot harvesting? Explain the reasons.

(vii) What will happen if wet gunny bags are not used during leaf harvest, transportation and storage?

ACTIVITY UNIT: 22

Transportation and Preservation of Leaves

22.1 Instructional Objectives

The pupil should be able to.

- understand the importance of leaf transportation/preservation;
- learn the methods of transportation/preservation;
- select the appropriate preservation procedure,
- understand the ill effects of bad preservation.

22.2 Relevant Information

Need for preservation of mulberry leaves

Silkworms are fed four to five times in a day at regular intervals. The mulberry leaves fed to silkworms should be nutritious and succulent to facilitate the larvae to eat and grow. Hence, an optimum level of moisture has to be maintained in the area where leaves are stored. The optimum level of moisture in the leaves should be 75-80% during the early age and 70-75% at the later age to make them palatable to silkworms. Hence, mulberry leaves/branches are harvested in the morning and afternoon, avoiding high temperatures, which will cause loss of moisture, and also to preserve them for feeding at night and at odd hours. Hence, there is need to preserve the leaves.

Is there any reduction in the nutritional level of leaves due to preservation?

It has been reported that there has been no loss in nutrients in mulberry leaves even after 24 hours of proper preservation. Steps must be taken to retain the moisture by covering the leaves with wet gunny cloth.

Conditions required for leaf preservation

It is desirable to preserve leaves at 20 deg. C or below and at more than 90% relative humidity. It is possible to create these conditions by using a wooden leaf chamber or keeping leaves/twigs on the floor covered with wet gunny cloth.

Leaf chamber

A leaf chamber is a wooden frame of 1.5 length x 0.8 width x 0.8m depth with many wooden vertical bars of 32 cm x 13 cm at regular intervals to support the frame.

Transportation of leaves

The mulberry garden is usually located near the rearing house. So mulberry leaves/shoots are transported either by headload or carts where the distance is more

22.3 Precautions

- Choose the proper time for harvesting
- Select quick means of transport
- Increase the humidity during preservation (90%).
- Decrease the temperature where leaves are preserved (20 deg.C).
- Cover with wet gunny cloth during transportation/ preservation.
- Take care that there is no fermentation of leaves by spreading them in the storage place

22.4 Materials Required

(i) Leaf basket
(ii) Gunny cloth
(iii) Leaf chamber
(iv) Mat
(v) Bullock cart
(vi) Wet and dry bulb thermometers
(vii) Sprayer
(viii) Weighing scale

22.5 Procedure

- Select leaves suitable to the silkworms in the garden
- Estimate the approximate requirement of leaves required for the worms in kilograms.
- Harvest leaves/shoots in the morning or in the afternoon.
- Use the leaf basket for transportation of leaves.
- Use the wet gunny cloth to cover the baskets.
- In the case of shoot harvesting, bundle up the shoots and cover them with wet gunny cloth and transport either on headloads or by carts.
- Transport the leaves to the place of storage as quickly as possible
- Select a place in the rearing house for storage of mulberry leaves
- Clean up this area with 2% formalin spray

- Spread the bamboo mat after drying the floor.
- Spread the harvested and transported leaves on these mats in a thin layer.
- Cover the leaves with wet gunny cloth.
- Check the temperature and humidity of the area where leaves are stored.
- Keep spraying/sprinkling water on the gunny cloth to keep the area moist.
- Every one or two hours, check the temperature inside the heap of the leaves by inserting the hand and alter the position of the heap of leaves followed by covering with the wet gunny cloth.
- In case a leaf chamber is used, preserve the leaves in the chamber after wetting the inner gunny cloth cover and cover the top of the leaf chamber with another wet gunny cloth.
- Keep on sprinkling/spraying water on the gunny cloth at intervals depending on the temperature and releative humidity prevailing in the storage room.

22.6 Observations

- Observe the quality of leaves being harvested.
- Weigh the basket with leaves after harvesting.
- Record the temperature and humidity in the room where leaves are under storage.
- Observe the dampness of the gunny cloth during transportation and storage.
- Feel the temperature inside the stored heap of leaves by inserting the hand.

22.7 Expected Behavioural Outcomes

The pupil will be able to:

- appreciate the importance of leaf preservation;
- learn the suitable leaf preservation technique;
- select the appropriate mode of transportation of leaves;
- understand that for a successful silkworm crop, leaf preservation is quite important.

22.8 Questions

(i) Why do you need to preserve leaves for rearing of silkworms?

(ii) What are the pre-requisites for preservation of leaves?
(iii) What happens if the leaves are not preserved well?
(iv) What is a leaf chamber and how effective is it to store leaves?
(v) What are the usual methods of transportation of mulberry leaves?

ACTIVITY UNIT: 23

Farm Record Maintenance

23.1 Instructional Objectives

The pupil should be able to:

- understand the importance of farm records;
- maintain some ledgers/records about the inputs and outputs of a mulberry farm;
- ultimately assess the cost of inputs for one kg. of mulberry leaves.

23.2 Relevant Information

Management is an important aspect in the success of the silkworm crops and the mulberry garden especially plays a key role.

Mulberry leaves with high nutritive value play a vital role in a successful silkworm crop.

The norms for maintenance of a mulberry garden such as frequency of irrigation, the pruning programme, the dosages of organic and inorganic manures have been listed; these are to be followed.

To evaluate the application of norms to the mulberry garden, an assessment has to be made after proper recording of the activities.

Five ledgers proposed to be maintained are:

(i) Plot Register

The necessity of this ledger is to find out the yield of leaves in a unit area and check whether all the norms of work have been adhered to (Format I - Annexure). The performance of each plot/ variety with several treatments can be assessed vis a vis the silkworm crop. Any lacunae observed could be made up by application of suitable doses of manure.

(ii) Work Register

The need for this would be explained by the utilization of labour (both men and women) in the maintenance of a mulberry garden and the several cultural operations. The mandays utilized for each cultural operation could be measured and the efficiency of labour could also

be assessed. This ledger will have a relevance with the plot register with the difference that this ledger gives the performance of the labour including the cultural operations each day whereas the plot register provides the information on each plot. The register has to be maintained in the following format. (See Format II – Annexure).

The work turned out on each day and the work attended to for each plot could be assessed.

(iii) Nominal Roll

The need for the maintenance of this is to take stock of the labour strength and also assess the attendance of each labourer. His punctuality and attendance could be checked. The attendance and the work allotted to him is marked by the superior every day.

The wage earned by each worker could be worked out depending on the number of days he has worked and his performance could be checked. The record has to be maintained in the following format (See Format III – Annexure).

(iv) Inventory

The inventory records information on the implements used in the garden as well as the stock of fertilizers and disinfectants and the cost of production of mulberry leaves.

Proper planning could be resorted to, with the information available in the inventory and sufficient stocks of fertilizers could be held for timely application. The inventory will be maintained in the following format (See Format IV – Annexure).

The inventory would also provide information on the dosage of manure applied and irrigation provided to a particular plot. Several parameters have been cited in the relevant Activity Units of this manual. These parameters will have to be compared with the actual production of leaves and the performance assessed. The points to be considered are:

(a) Irrigation/No irrigation
(b) Farmyard manure
(c) Chemical fertilizer

However, the total cost of labour input may be considered for calculating the cost of output.

The total quantity of mulberry leaves produced and the cost involved on the several inputs have to be worked out and the cost per kg of leaves calculated as follows:

Expenditure on inputs/Amount of mulberry leaves harvested =

Cost per kg of mulberry leaves produced

(v) Metereological Records

Temperature and rainfall have a great bearing on the productivity of mulberry leaves. The daily record of maximum and minimum temperatures and rainfall should be recorded (See Format V – Annexure).

23.3 Precautions

- Maintain the registers in the required proforma .
- Make the entries clearly with necessary attestation.
- Compare the entries in the nominal rolls/plot register/work register.
- Watch the balance of stock of manure/materials.

23.4 Materials Required

(i) Ledger
(ii) Nominal roll forms
(iii) Maximum and minimum thermometers
(iv) Rain guage

23.5 Procedures

- Select good ledgers.
- Write down the format in the ledger.
- Record the work done each day in the nominal roll/work register and plot register.
- Record the receipts/issue of materials/manure, etc. each day.
- Record maximum and minimum temperatures daily and rainfall as and when.

23.6 Observations

- Observe the work done each day and countercheck with the plot register.
- Observe whether the number of labourers as indicated in the nominal rolls corresponds with the number mentioned in the work register.
- Observe whether the plot has received the required cultural operations.
- Observe whether the requisite inputs such as irrigation, manure/fertilizer and plant protection measures have been provided in time.

23.7 Expected Behavioural Outcomes

The pupil will be able to:

- know the number of labourers functioning each day;
- understand the cultural operations given and the dosage of manure provided to each unit (plot);
- plan the requirement of equipment and stocks of manure to be preserved for proper application;
- assess the quantum of work done by the labourers for the various operations;
- work out the cost of production of one kg of mulberry leaves.

23.8 Questions

(i) How do you calculate the cost per kg of mulberry leaves produced?

(ii) How do you evaluate the inputs and cultural operations of each unit area/variety?

(iii) How do you record the metereological data in a mulberry farm, and relate them to the harvest of mulberry leaves?

(iv) How do you compare the manpower utilized each day using Formats II and III?

(v) How do you find out the stock of manure and availability of garden equipments?

Annexure

Format I: PLOT REGISTER

Survey No

pH Value

Plot No	Area	Variety	Date of planting	Date of pruning	Application of manure			Irrigation	Crop	Date	Qty of leaves harvested (kgs)	Remarks
					Qty of FYM	Qty. of chemical manure						
						Straight fertilizer	Complex fertilizer					
1	2	3	4	5	6	7	8	9	10	11	12	13

Annexure

Format II: WORK REGISTER

Date	No of workers			Work alloted						For compost-ing	General Mainte-nance	Remarks
	Men	Women	Total	Digging	Weeding	Pruning	Manuring	Harvesting	Planting			
1	2	3	4	5	6	7	8	9	10	11	12	13

Annexure

Format V: METEREOLOGICAL RECORDS

Date	Temperature °C		Rainfall mm	No. of rainy days
	Maximum	Minimum		

ACTIVITY UNIT: 24

Visit to a Mulberry Farm

24.1 Instructional Objectives

The pupil should be able to:

- acquire knowledge about the site and other facilities for a mulberry farm;
- know about the difference activities conducted on the farm;
- study the economics of maintenance of a mulberry garden by a private individual;
- study the efficiency of the individual to harvest good cocoon crops utilizing the leaves from the mulberry garden;
- compare the yield of leaves between the varieties and also between rainfed/irrigated plantations.

24.2 Relevant Information

Why is the visit necessary?

The visit would be necessary to evaluate the efficiency in the maintenance of a mulberry garden and the resultant effect on silkworm crops The attempts made by private individuals in economizing on labour and other inputs could be studied. The efficient way of co-ordinating the harvest of mulberry leaves and the silkworm rearing may be studied. The variety of the mulberry plays an important role in the yield of leaves, and so also the irrigation. The proper dosage of farm yard manure and chemical fertilizer would enable the individual to produce nutritive leaves fit for raising silkworms. Speedy transport and measures adopted and proper storage facilities provided to the mulberry leaves to ensure maintenance of quality of the leaves would be studied. Exposure to different mulberry farms will enable students to acquire first hand knowledge about the levels of efficiency in the maintenance of a mulberry farm.

The various activities to be Studied are:

(a) Planting method
(b) Variety

(c) Irrigation/Rainfed
(d) Type of soil
(e) Quantity of farmyard manure applied
(f) Quantity of chemical fertilizers applied
(i) Straight fertilizer
(ii) Complex fertilizer
(g) Harvesting/storing of mulberry leaves
(h) Capacity of the sericulturist to brush layings, based on the leaf production in the garden

There will be a comparative study between different varieties, irrigated and rainfed crops, and proper dosage of fertilizer or otherwise.

24.3 Precautions

- Select the farmers and fix up the date of the visit well in advance.
- Do not enter the garden without the farmer.
- Make notes carefully on all the aspects observed.

24.4 Materials Required

(i) Note book
(ii) Metre scale/measuring tape
(iii) Altimeter in the case of a high altitude place

24.5 Procedure

- Fix the date of the visit beforehand with the owner of the garden.
- Go around the garden with the owner
- Record the location, area, variety, date of planting, cultural operations, inputs, etc.
- Critically study the various components such as inputs, etc.
- Study the type of green manure the farmer is using.
- Note the date of pruning and the number of crops he has harvsted.
- Note the time of harvesting and storage facilities provided.
- Work out the approximate cost per kg of leaves by calculating the inputs.
- Study the behaviour of cocoon crops fed with leaves from the garden.
- In the case of failure of any of the crops, study whether a soil test has been conducted and whether proper inputs

have been added.
- Study the fencing material used and safety measures taken to avoid animals feeding on leaves.
- Record the plant protection measures adopted.
- Draw a plan of the garden and locate the well, mulberry variety, fence, etc. Enquire about the cost of cultivation, gross profit and net profit.

24.6 Observations

The pupil should record the following:
- Location.
- Irrigated/rainfed.
- Variety.
- Date of plantation.
- Number of harvests per annum.
- Quantity and dosage of manure and fertilizers.
- Green manuring if any.
- Plant protection measures.
- Capacity of the sericulturist in terms of layings being brushed per annum.
- Record the cost of production of leaves, gross income and net income from silkworm rearing.
- Compare the plantations between rainfed/irrigated and different varieties.
- Record notes on all these aspects.

24.7 Expected Behavioural Outcomes

The pupil will be able to:
- understand the proper location of the farms;
- learn about preparation of land and planting methods;
- know about irrigation and use of fertilizers;
- observe the difference between rainfed/irrigated gardens;
- distinguish between different varieties of mulberry;
- properly programme the brushing and the leaf harvest;
- learn the economics of the maintenance of a mulberry garden;
- understand the importance of plant protection measures;
- increase the productivity per unit ara by providing proper inputs.

24.8 Questions

(i) How do you locate the mulberry garden and what are the points to be noted?

(ii) Which variety is suited to the area and what is the type of plantation?

(iii) How do you account for the difference in yield of leaves between irrigated and rainfed mulberry gardens?

(iv) Have any of the farmers adopted plant protection measures? If so, what are they?

(v) Has any farmer lost the silkworm crop and could this be linked to the poor maintenance of the mulberry garden? If so, have you identified the reasons?

(vi) Has any farmer adopted a package of practices recommended by the R & D Departments for mulberry cultivation? If so, what is the impact?

(vii) Is the farmer applying any green manure? If so, which type of green manure he is using?

(viii) Have you assessed the performance of each farmer you have visited and what are your recommendations?

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